Review of the historical and existing natural environment and resource uses on the Ottawa River.

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ONTARIO POWER GENERATION

Ontario

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Abstract

The Ottawa River is one of the magnificent water bodies in eastern Ontario. Sculpted 11,000 years ago by the retreat of the Wisconsin glacier, its history is rich with exploration, discovery, transport and settlement. In the past 100 years, significant changes have occurred along the river altering it course, and taming its wildness. The most significant changes have resulted from man harnessing some of the river's natural power. Vast areas were flooded and natural rapids were eliminated as the river underwent hydroelectric development. Between the 1880's and 1964, seven hydroelectric dams were constructed between Carillon and Lake Temiscaming. In this report, we review the historical conditions of this section of river prior to hydroelectric development. This includes an array of historical aerial mosaics, archived photographs and descriptions of predevelopment conditions and current views of existing structures. In addition, we review the existing environmental conditions in the various reaches including current hydrology, flora and fauna, significant species, parks, and environmentally sensitive areas along the river. The intent of this report is to establish a reference document for the water manager to identify significant features along the river and for the fisheries manager to assist in the understanding of past and current influences to not only the fisheries of the river, but other associated biota.

Résumé

La rivière des Outaouais est un des plus magnifiques cours d'eau de l'Est de l'Ontario. C'est le recul du glacier du Wisconsin qui, il y a quelque 11 000 ans, a creusé son lit. Voie d'exploration, de découverte, de transport et de colonisation, elle connaît depuis une histoire riche. Les cent dernières années ont vu des transformations importantes, en particulier à la suite des activités humaines visant à capter l'énergie hydraulique naturelle de la rivière. Tout au long de son cours, certaines régions ont été submergées et des rapides naturels ont disparu dans le cadre de son aménagement hydroélectrique. De 1880 à 1964, sept barrages hydroélectriques ont été construits entre Carillon et le lac Témiscamingue. Le présent rapport examine l'histoire de ce segment de la rivière avant son aménagement hydroélectrique. On y présente une mosaïque de photos aériennes historiques, de photos d'archives et de descriptions de l'état de la rivière avant son aménagement, accompagnés de vues des ouvrages en place aujourd'hui. En outre, on y examine l'état actuel de l'environnement dans divers domaines, y compris l'hydrologie, la flore et la faune, les espèces importantes, les parcs et les milieux écologiquement sensibles en bordure de la rivière. Le rapport a pour objet l'élaboration d'un document de référence qui permettra aux responsables de l'eau de reconnaître les caractéristiques marquantes des influences anciennes et actuelles, non seulement sur les poissons de la rivière mais sur la biote qui est associée.

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Acknowledgements

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Finally, we would like to thank Lyn Thompson of Southcentral Science and Information in North Bay for editing, formating, and publishing this document.

Introduction

The mighty Ottawa River, historically known as Kichesippi (the Great River). It is the largest all Canadian river in eastern Canada, flowing through the nation's capital with as much history as it has power. At one time considered to be the gateway to the east, it was the route of Samuel de Champlain's explorations, the travel corridor of the Voyageurs. This river became the highway of the fur trade and later, the main artery for transporting logs to European markets. It aided the colonization of a great country to such an extent that the nation's capital was built on its shores. Historically, dams and canals were constructed along sections of the river either to harness its power or avoid the power of its countless falls and rapids. However, it was in 1943, when the Ontario and Québec governments signed an agreement to allocate between them the undeveloped water power sites on the Ottawa River (Ottawa River Engineering Board 1965; Hincks 1978), that the greatest changes would result along its course.

The Ottawa River took its shape approximately 11,000 years ago with the retreat of the Wisconsin glacier. For thousands of years, it sculpted the Ottawa Valley (Chapman and Putnam 1984). The Champlain Sea, a marine environment, once flooded the valley as far upstream as Point Alexander (Barnett 1989). Hence, colonization by fish came primarily from the Mississippian refugium, from the Great Lakes via the Fosmill Outlet and later via the Mattawa Outlet, although some species arrived from the Atlantic Coastal Plain (McAllister and Coad 1974). After the retreat of the glacier, the course of the Ottawa River remained relatively unchanged until the 20th Century.

The Ottawa River flows for approximately 1,130 kilometres (km), from its origins at Lake Capitmitchigama in Québec to the confluence at the St. Lawrence River (Legget 1975), and has a vertical descent over its course of 365 metres (m) (Telmer 1996). The Ottawa River itself is a tributary representing approximately 11.2 percent (%) of the total drainage area of the St. Lawrence (Telmer 1996). It forms a natural provincial border between Ontario and Québec for approximately 580 km from Lake Temiscaming to Carillon (Chapman and Putnam 1984). The watershed is approximately 146,000 kilometres square (km^2), of which 65% is within the province of Québec (Telmer 1996). The mean annual flow of the Ottawa River is 1,968 cubic metres per second (m^3/s) (Telmer 1996).

There are numerous tributaries of the Ottawa River, which are listed when describing each section of the report, many of which have also been dammed. Currently, there are 43 dams within the watershed, seven of which are on the main course of the river (Environment Canada et al. 1985), forming more than 14 billion metres cubed (m^3) of water storage capacity (Ottawa River Regulation Planning Board 1984). Regulation of the river commenced early in history, as evident by the reduction in the ratio of maximum to minimum flow from about 10:1 in 1870, to 5:1 by 1930 (Legget 1975). All of the dams and reservoirs in the Ottawa River basin make it one of the most highly regulated catchments in Canada (Telmer 1996).

Study objectives and scope

Objectives

The purpose of this report is to provide a comprehensive reference document that illustrates the historical and existing state of the environment of the Ottawa River. The objective of this report is to review the environmental and resource uses of the Ottawa River. This includes a review of the physical conditions of the river prior and after hydroelectric development in various reaches of the river; describing the present hydrology (including current water management regimes); chemical characteristics; associated biota; wetlands and significant areas (ANSI and RPF[1]) along each

[1] ANSI = Area of Natural and Scientific Interest; RPF = reserve ecologique.

reach; and shoreline development. This report is intended to be a reference document for the water manager to identify the significant features along the river, and/or to assist the fisheries manager in understanding past and current influences to not only the fisheries of the river, but other associated biota.

Study area

Although the Ottawa River extends from the confluence at the St. Lawrence River to its head waters at Lake Capitmitchigama, this report pertains to the section from the Carillon Dam to the public dam at Lake Temiscaming (Figure 1). For the purposes of the report, the river has been divided into reaches, generally based on the presence of a dam. The reaches are as follows:

- Lac Dollard des Ormeaux (Carillon to Chaudière Falls)
- Lac Deschênes (Chaudière Falls to Chats Fall/Fitzroy)
- Lac des Chats (Chats Falls/Fitzroy to Cheneaux Dam)
- Lac du Rocher Fendu (Cheneaux Dam to La Passe)
- Allumette Lake and Lac Coulonge (La Passe to Des Joachims Dam)
- Holden Lake (Des Joachims Dam to Otto Holden Dam)
- Lac la Cave (Otto Holden Dam to the public dam at the outflow of Lake Temiscaming)

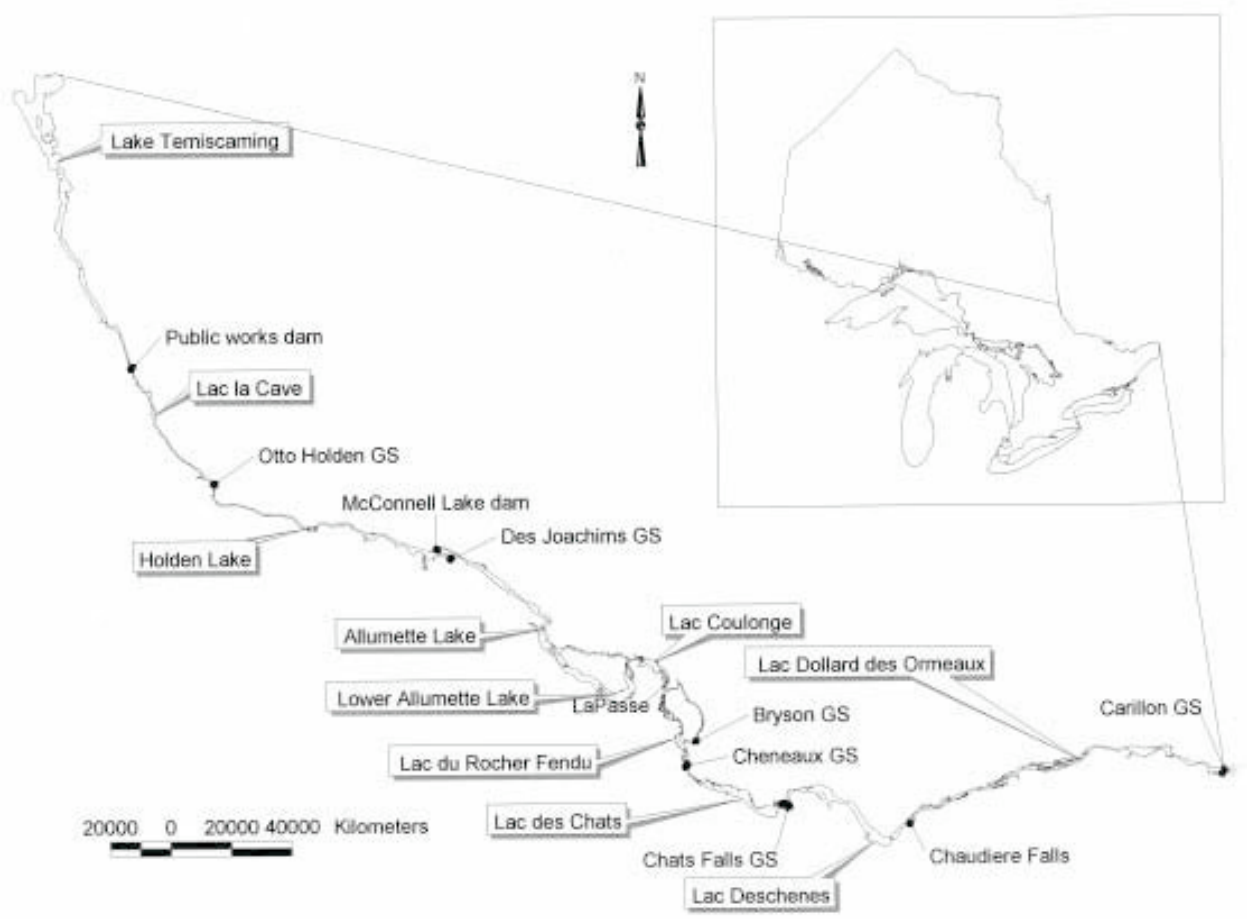

Figure 1. Reaches of the Ottawa River and locations of dams from Carillon to Lake Temiscaming.

This report describes each section travelling upstream from Carillon. The reason for this approach is to describe the control structure for the reach, if one is present, and then describe the impoundment. In addition, using the historical information, it recreates the obstacles that early explorers encountered on their travels up the river.

Study approach

This study was conducted in several phases. The historical review included reviewing all documents pertinent to the Ottawa River, specifically those that detailed conditions prior to the construction of the hydroelectric dams. Libraries, bookshops, archives and journals were searched for relevant information. Historical photographs were obtained from the National Air Photo Library, National Archives of Canada, Hydro One Archives, Hydro-Québec Archives, and the Ontario Ministry of Natural Resources Information Centre.

The present hydrology was obtained from the Ottawa River Regulation Planning Board, Ontario Power Generation (OPG) and Hydro-Québec.

The remainder of the data on sensitive species and areas, fisheries, wildlife, and chemical characteristics were obtained from the various managing agencies such as the Ontario Ministry of Natural Resources (OMNR), Société de la Faune et des Parcs du Québec, as well as a 1993 field reconnaissance by OPG staff. The intent of this document is to offer general descriptions of what is found in each reach. More detailed descriptions and mapping, specifically on sensitive species, can be obtained from the sources identified.

Overview

Originating in a chain of lakes in Québec, Grand Lac Victoria, and Reservoir Dozois, the Ottawa River winds its way westward through Reservoir Decelles, Lac Simard and Lac Des Quinze before flowing southward into long narrow Lake Temiscaming. Here the river emerges from a mixed forest of balsam fir, black spruce, and aspen (in the Missinaibi-Calonga section of the Boreal Forest Region) into a settled area of agricultural, mining, and lumbering interests (in the Haileybury Clay and Temagami sections of the Great Lakes Forest Region) (Rowe 1972).

At the southern end of Lake Temiscaming, the river plunges back into a transitional forest (the Algonquin-Pontiac section of the Great Lakes-St. Lawrence Forest Region) running generally southeastward past the towns of Mattawa and Deux Rivières. The banks of the river are steep and rocky in nature. Approaching the town of Pembroke, the river widens out around Allumette Island with forest giving way to agricultural lands on a sand plain (a delta formed in the Champlain Sea by rivers such as the Petawawa and Ottawa) interspersed with Precambrian rock outcrops along the lowlands of the Ottawa Valley (the Ottawa Valley Clay Plains of Lake Algonquin) (Chapman and Putnam 1984). Leaving Pembroke, the river widens and there are a number of lake-like stretches broken by the rapids at Île du Grand Calumet as the river flows toward the city of Ottawa. Along this section of the river the forest becomes more deciduous in composition, being dominated by maples, beech, birch, and oaks (the Upper St. Lawrence Section of the Great Lakes-St. Lawrence Forest Region).

The diversity and distribution of fish and wildlife species have been affected by development of the Ottawa River, in particular, hydro-electric generation. The dams have blocked migratory species, such as American shad and eels, to the degree that they are very low in numbers or absent from the Ottawa River. There are eighty-five fish species documented to inhabit the Ottawa River (Appendix 1). The river redhorse, a provincially rare species, is present in various reaches and tributaries of the river. The Ottawa River provides a recreational resource primarily for sport fishing, hunting and boating. Sport fish in the area include muskellunge, largemouth bass, walleye, northern pike, smallmouth bass, and yellow perch. The water quality and thus the fishery in the Ottawa River are considered to be better than 30 years ago due to

regulations on industrial effluents and the eventual decline of log drives on the river.

The Ottawa River system has a great diversity of habitats supporting wildlife, birds and plant communities. Over 300 bird species inhabit the study area (Sankey 1987). As evidence of this diversity, the Ontario Ministry of Natural Resources and Société de la Faune et des Parcs du Québec (SFEP) have established a number of parks, Areas of Natural and Scientific Interest (ANSI) and ecological reserves (RPF) within the study (Table 1) (Chabot 1992; OMNR 2001a).

Changes in habitat, due to hydro-electric development, has had its impact on wildlife habitat. The loss of historic mud flats and creation of new habitat has affected shorebird populations (Sankey 1987). Yet flooding has created wetlands for other birds such as waterfowl (Munro 1967). The Ottawa River is considered to be most important as a waterfowl flyway during migration especially for northern species, e.g. brant, arctic terns, and red-throated loons (McKeating 1990). Waterfowl nesting occurs within floodplain wetlands located within or adjacent to the river (protected by beaver dams or barrier beaches).

Yet, the diversity and distribution of bird species has also been affected by other factors related to the "development of the river". Birdwatching in the upper Ottawa River Valley was first mentioned in 1889, in an article "The Birds of Renfrew County" by Rev. C.J. Young who wrote:

> *"The grown people who have spare time, don't trouble themselves at all about the birds ... I hear of birds being shot at all seasons for no earthly purpose whatever ... in the part of Ontario where I live [the birds] are yearly diminishing."*

Thus, even before the advent of hydroelectric generation, species such as raptors (e.g. breeding golden eagles) and migrating waterfowl were decreasing in number and variety (Sankey 1987).

Although much of the southern reach of the Ottawa River is privately owned, the northern section of the river is Crown land. The development of the Ottawa River has affected resource users in these reaches of the river. Water resource users such as native people, canoeists, hunters, and fishermen, who prefer a pristine, undisturbed setting may be more affected by development. Other users who prefer cottaging and other lake-oriented recreations may be less affected by development such as hydroelectric development.

Lac Dollard des Ormeaux (Carillon to Chaudière Falls)

Pre-development description

Historically, the first major set of rapids encountered when traveling up the Ottawa River from Lac des Deux Montagnes was the Long Sault, which comprised three main sets of rapids: Carillon Rapids, Chute à Blondeau, and Long Sault Rapids (Figure 2). This was a 20.9 km section that cascaded approximately 18.3 m in elevation from Grenville to Carillon (Lambart and Rigby 1963).

The Carillon Rapids were the lowest set of rapids of the three in the Long Sault. These rapids were described by an engineer in 1860:

> "*At Carillon, the river is obstructed 1.3 miles by a reef of calciferous sandstone with only two to three feet of water running over it, except in the 'sickle channel', about 150 feet wide and nine or ten feet deep and, as its name implies, very crooked*" (Lambart and Rigby 1963).

The fall at the Carillon Rapids was 2.7 m and the current was very strong (Figure 3) (Lambart and Rigby 1963). The next set of rapids, Chute à Blondeau ("The Chute") was located shortly upstream and was a narrow channel cut through a rock shelf to a depth of 4.0 m (Lambart and Rigby 1963). This set of rapids was relatively short and had a fall of about 1.2 m (Legget 1975). Shortly upstream, the Long Sault rapids were encountered. These rapids were comprised of five or six smaller rapids (Lambart and Rigby 1963), extending for more than 9.7 km between Grenville and Greece's Point (Figure 4) with a drop of approximately 14 m

Table 1. Environmentally sensitive areas by river reach.

River Section	Environmentally Sensitive Area
Lac Dollard des Ormeaux	Parc de Conservation de Plaisance
	Voyageur Provincial Park Earth Science ANSI
	Rockland Precambian Earth Science ANSI
	Baie Lafontaine Islands Candidate Life Science ANSI
	Petrie Island Wetland Candidate Life Science ANSI
	Green Creek Conservation Area Life Science ANSI
	Duck Islands Candidate Life Science ANSI
Lac Deschênes	Britannia Conservation Area Candidate Life Science ANSI
	Ottawa Beach Wetland Candidate Earth Science ANSI
	Shirley's Bay Wetland Earth Science ANSI
	Constance Creek Wetland Life Science ANSI
	Horseshoe Bay Shores Candidate Life Science ANSI
	Constance Bay Sandhills Earth Science ANSI
	Fitzroy Provincial Park
Lac des Chats	Mississippi Snye Wetland Life Science ANSI
	Morris Island Conservation Area Life Science ANSI
	Projet du Refuge Faunique de Bristol
Lac du Rocher Fendu	Provincial Waterway Park
Allumette Lake and Lac Coulonge	La Passe Pipeholes Earth Science ANSI
	Petawawa Terrace Life Science ANSI
	Ruisseau de l'Indien RPF*
	James Little RPF
	De l'Aigle à Tête Blanche RPF
Holden Lake	André Linteau RPF
	Driftwood Bay Provincial Park
Lac la Cave	Alexander Lake Forest Life Science ANSI
	Jocko/Ottawa River Earth Science ANSI
	Colton Narrows Life Science ANSI
	Pinetree Point Life Science ANSI

*RPF is a Quebec designated project de reserve ecologique. A reserve ecologique is given the highest level of protection in Quebec

Source OMNR 2001a; SFEP 2001

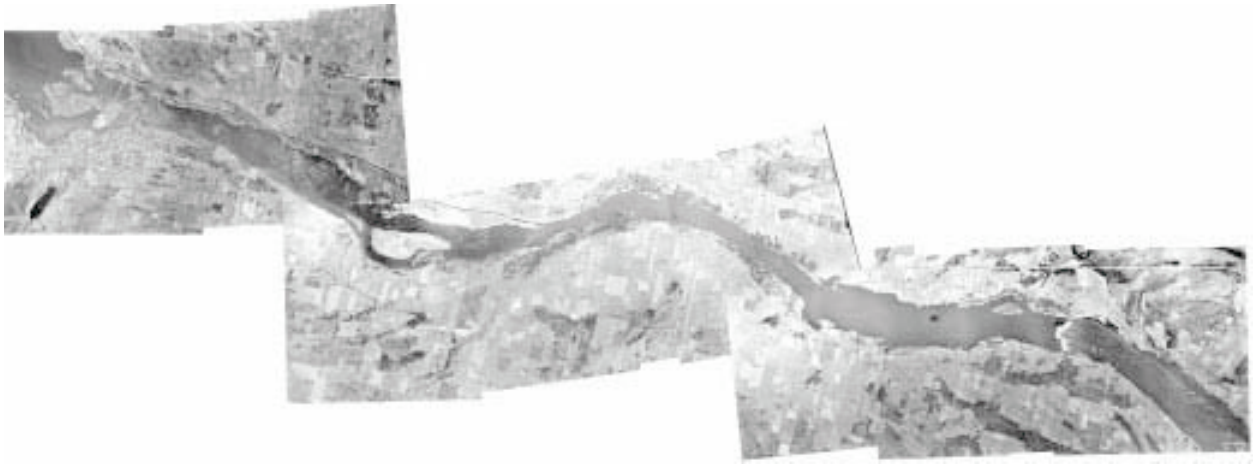

Figure 2. Aerial photograph mosaic of the Ottawa River from Carillon to Hawkesbury illustrating the Long Sault, 1957.

Figure 3. Carillon Rapids, 1983 (National Archives of Canada PA 85631).

Figure 4. View of the Ottawa River from Grenville overlooking Greece's Point prior to the construction of Carillon Dam (Quebec Hydro Archives).

(Lambart and Rigby 1963; Lafrenière 1984). The natural variation in the water level that occurred at these rapids was generally between 2.1 and 2.4 m, but occasionally reached 4.6 m (Lambart and Rigby 1963). Large rocks were prevalent in these rapids (Lafrenière 1984).

The Long Sault was an obstacle for early navigation, sometimes requiring several days to ascend (Lambart and Rigby 1963). To make passage easier, canals were constructed to bypass the Carillon Rapids, Chute à Blondeau and Long Sault Rapids. The primary reason for the construction of these canals was to establish a travel corridor into Canada that was located away from the St. Lawrence in case of war with the United States (Lambart and Rigby 1963). The construction of the canals officially started in 1819, however, excavation did not actually take place until 1821. Three canals were finally opened in 1834 (Legget 1975). Carillon Canal was 4.7 km in length and contained three locks; the Chute à Blondeau canal was 0.26 km in length and contained one lock; and the Grenville Canal was 9.3 km in length and contained seven locks (Lambart and Rigby 1963). This system was upgraded in the 1870's to 1880's and included the construction of the first dam at Carillon (Lafrenière 1984). It was a rock-filled crib dam constructed in 1870 by the Department of Public Works (Figure 5), intended to assist logging operations on the river (Legget 1975). The dam

Figure 5. Old crib dam at the Carillon site (Quebec Hydro Archives).

Figure 6. Carillon Dam during the spring flood of 1908 (National Archives of Canada PA 85631).

extended 549 m across the river and contained a log slide 67 m wide and 168 m long to permit the passage of timber rafts (Lafrenière 1984). The dam raised the water level 2 m (Lambart and Rigby 1963), flooding the slight rise in the single lock of Chute à Blondeau (Legget 1975) and submersing the Chute à Blondeau rapids (Lafrenière 1984). The construction of the dam permitted water to flow over top of the structure (Figure 2 and 6). As a result of the dam, the current at Carillon was gentle (Figure 7; Lambart and Rigby 1963). The upgraded canals were opened in 1882 (Lafrenière 1984). Figure 2 illustrates the canals at Grenville and Carillon prior to the construction of the Carillon Dam by Hydro-Québec.

Existing physical description

The Carillon Generating Station (GS) was constructed at the site of the old dam to supply hydro to the Montreal area during peak hours (Lafrenière 1984). The dam was constructed between 1959 and 1963, and was operational by 1964 (Legget 1975; Lafreniere 1984; Hydro-Québec 1996). The Carillon Dam is 1,128 m long, 19.8 m wide and 16.8 m high (Figure 8; Lafrenière 1984). The generating station has 14 units that are operational (Legget 1975; Hydro-Québec 1996). A 7.6 m high dyke was constructed on each side of the upstream portion of the dam (Lafrenière 1984). The dyke on

Figure 7. Carillon rapids prior to the construction of the Carillon Dam (Hydro-Quebec Archives).

Figure 8. The Carillon Generating Station observed from downstream on the west shore.

the left side of the dam is 4.5 km and on the right side, 1 km (Hydro-Québec 1996). There is an operational lock on the north side of the dam that allows the movement of boat traffic up and down the river. Additional features of the Carillon Dam are outlined in Table 2. In this reach of river, the water levels rose an average of 1.8 m over a distance of 96.6 km (Munro 1967) flooding out Chute à Blondeau and Long Sault rapids (Lambart and Rigby 1963; Lafrenière 1984). Water levels rose 18.9 m at Carillon, 2.7 m at Grenville and 0.9 m at Masson (Lafrenière 1984). A water surface profile of the Ottawa River (Figure 9) illustrates the extent of changes that occurred in this section of the river as a result of the construction of the dam. Despite the rise in the water levels, there was a relatively small area flooded (Efford 1975).

Lac Dollard des Ormeaux is the reach of river between the Carillon Dam and Chaudière Falls. It has a length[2] of approximately 113.1 km and a surface area of 14,414 ha. This portion of the river consists of a main channel and a large floodplain. There are no rapids or fast water, however, there is a strong current present throughout most of the reach. Water depths may reach 95 to 100 m in the main channel but probably average from 6 to 8 m.

The north shore (Québec) of the river consists mostly of shallow bays (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). Generally, the southern

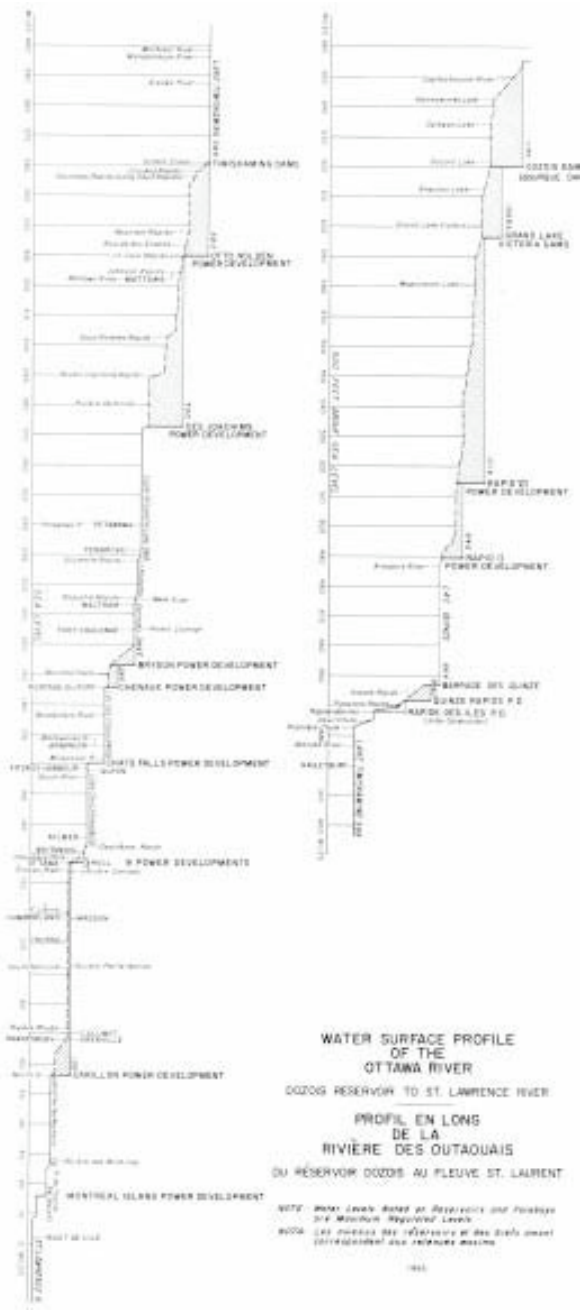

Figure 9. Water surface profile of the Ottawa River (Ottawa Engineering Board 1965).

shoreline (Ontario) has much less littoral habitat and is characterized by a relatively steep sloping channel. The river bottom in this reach is mainly

[2] Length was calculated by measuring the midline of the river between designated points.

Table 2. Generating station characteristics.

	Owner	Inservice Date	Installed Capacity (MWH)	No. of Units	No. of Dams	No. of Sluices Gate/Log	Normal Head (m)	TurbineType/ Runner Diameter (m)	Operating Range (m)	
									Absolute Min	Absolute Max
Carillon	HQ	1964	654.5	14	1	12/	18.0	Kaplan	n/a*	n/a
Hull 2	HQ	1920	4.5	4	2	n/a	9.8/11.0	n/a	n/a	n/a
E.B. Eddy	EB	n/a	9.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Chaudiere 2 & 4	OH/EB	n/a	12.0	n/a	n/a	50/	n/a	n/a	n/a	n/a
Chats Falls	OPG /HQ	1931/32	192.0	8	6	4/76	15.6	Vertical Propeller/4.9	73.97	74.22
Chenaux	OPG	1950/51	122.0	8	3	7/24	11.6	Vertical Propeller/5.2	84.73	n/a
Bryson	HQ	1925	61.0	3	2	12/	18.3	Vertical Francis (G1 &2) & Kaplan (G3)	n/a	n/a
Des Joachims	OPG	1950/51	432.5	8	2	6/40	40.6	Vertical Francis/ 4.4	149.05	152.40
Otto Holden	OPG	1952/53	240.0	8	1	6/41	24.0	Vertical Francis/ 4.5	173.74	177.70

*n/a = data not available

covered by rock, gravel, sand, and silt (Ontario Water Resources Commission and Quebec Water Board 1972).

There are at least 47 tributaries in this portion of the Ottawa River (26 in Québec and 21 in Ontario) (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). The main tributaries of this section include Rivière Nord, Rivière Rouge, South Nation River, Rivière Petite Nation, Rivière Lièvre, Rivière Gatineau, and Rideau River. The mean annual discharge of selected tributaries is described in Table 3.

Present hydrology

Carillon receives the full flow of the Ottawa River basin (drainage area is 143,000 km^2) and has a mean annual discharge of 1,933 m^3/s (Telmer 1996). The maximum discharge recorded at Carillon was 8,190 m^3/s in 1976 and the lowest was 306 m^3/s in 1971 (Hydro Québec 1996).

Water levels in this reach of the river are regulated by the Carillon Dam. Carillon (generating station) GS is operated as a run-of-river (very little water storage) plant during the summer months and as a peaking system (water is passed and hydro produced only during periods of high demand) between October and April (Hydro Québec 1996). Water level changes are relatively stable during the summer months since the operation of the Carillon Dam restrains the spring flood to only about 50 centimetre (cm) for a period of approximately two to three days each spring (Figure 10). Daily fluc-

Table 3. Mean annual discharge (m^3/s) of various tributaries of the Ottawa River.

Tributary	Reach	Drainage Area (km2)	Mean annual discharge (m3/s)	Dam Controlled
Rideau	Dollard des Ormeaux	3830	39.1	Yes
Gatineau	Dollard des Ormeaux	22500	350.6	Yes
Lievre	Dollard des Ormeaux	4530	163.6	Yes
Petite Nation	Dollard des Ormeaux	1330	22.5	No
South Nation	Dollard des Ormeaux	3810	41.8	
Rouge	Dollard des Ormeaux	5460	104.6	
Nord	Dollard des Ormeaux	1170	36.9	
Quyon	Deschênes			No
Bonnechere	Chats	2380	19.7	Yes
Madawaska	Chats	8160	93.0	Yes
Mississippi	Chats	2900	30.6	Yes
Petawawa	Allumette	4120	48.3	No
Schyan	Allumette			No
Muskrat	Allumette			Yes
Noire	Coulonge			No
Coulonge	Coulonge	5150	75.0	No
Mattawa	Holden	909	15.5	Yes
Jocko	La Cave			No
Dumoine	Holden	3760	60.3	Yes

Source: Telmer 1996

tuations occur in the reservoir level during winter. The average annual water level drawdown is at the maximum of 1.5 m (Efford 1975).

Chemical Characteristics

Water surface temperatures mid summer in this reach are approximately 24 degrees celcius (°C) (Regional Municipality of Ottawa-Carleton [RMOC] 1999). This reach may be classed as mesotrophic-eutrophic with the water being very turbid as a result of high sediment content (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). This high turbidity has often resulted in poor dissolved oxygen levels. Sediments consist mostly of fine clay particles.

This reach of river has been affected by the greatest number of point and non-point source inputs (Environment Canada et al. 1985). Historically, total phosphorous concentrations and nitrogen-containing compounds (e.g. ammonia) have been high, as have metals such as copper, iron and lead, polychlorinated biphenyls (PCBs) and dichlorodiphenyl trichloroethane (DDT). Recent levels of metals in this reach are outlined in RMOC (1999). Total Kjeldahl nitrogen levels measured between 1970 and 1984 at Carillon and Hawkesbury have averaged between 0.3 and 0.5 milligrams per litre (mg/l) with highs of 2.65 mg/l (Telmer 1996). Organic pollution downstream of the pulp and paper mill in Hull has previously been a major factor in limiting the abundance and diversity of mollusks (Mackie and Quadri 1973). High bacteria have been reported in this reach (Regional Municipality of Ottawa-Carleton 1992).

In the past, biological oxygen demand (BOD) levels sampled in the Hawkesbury section of this reach have tended to range between 0.5 and 2.5 mg/l

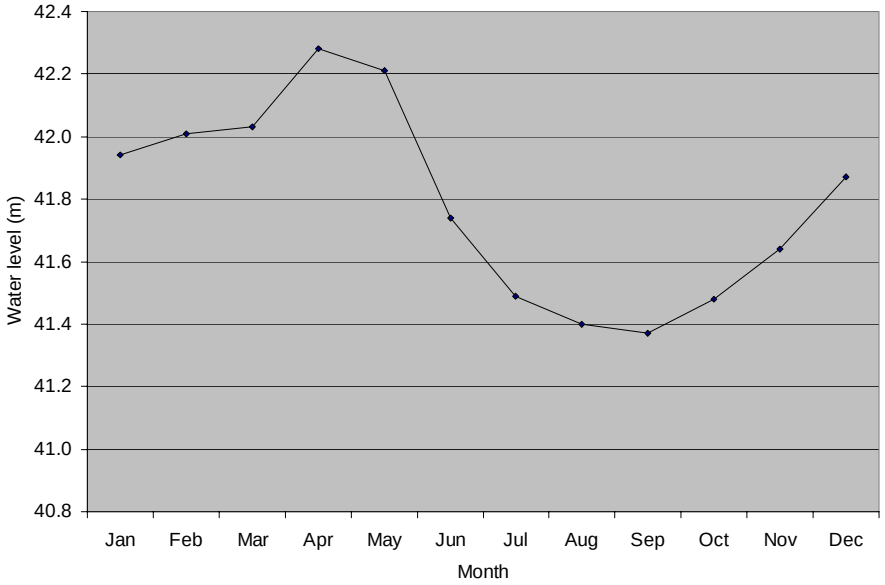

Figure 10. Mean monthly water levels in Lac Dollard des Ormeaux since 1964.

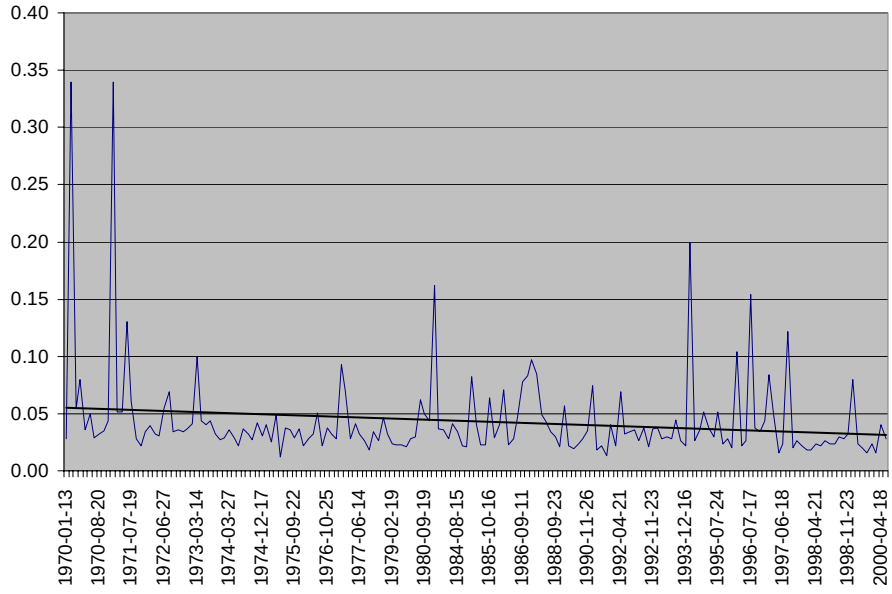

Figure 11. Total phosphorous levels at Hawkesbury (1970-2000).

(Figure 11) and total phosphorus between 0.025 and 0.1 mg/l (Figure 12). Recent phosphorus levels range between 0.02 and 0.03 mg/l in this reach. The pH is 7.5 (RMOC 1999).

Natural environment

Fisheries

This portion of the Ottawa River supports a relatively diverse coolwater/ warmwater fish community comprised of at least 75 different fish species (Appendix 1). Sport species include walleye, sauger, northern pike, muskellunge, yellow perch, smallmouth bass, largemouth bass, sturgeon, and black crappie (Table 4). The Ottawa River has always provided many species of fish. Reference is made to the small village of Chute à Blondeau, 11 km east of Hawkesbury, which possessed a government wharf and was a port of call for the freighters on their voyage from Montreal to Ottawa.

"Among other things which contributed to render this place one of considerable celebrity, was its excellent fishing grounds, many varieties of fish—shad especially —being caught in large numbers. During the decade following 1845, as many as 1200 fish were sometimes caught in one day, and though they rapidly decreased from that time, 400 were often caught in a day during the two or three years which preceded the building of the dams" (Department of Lands and Forests, 1964).

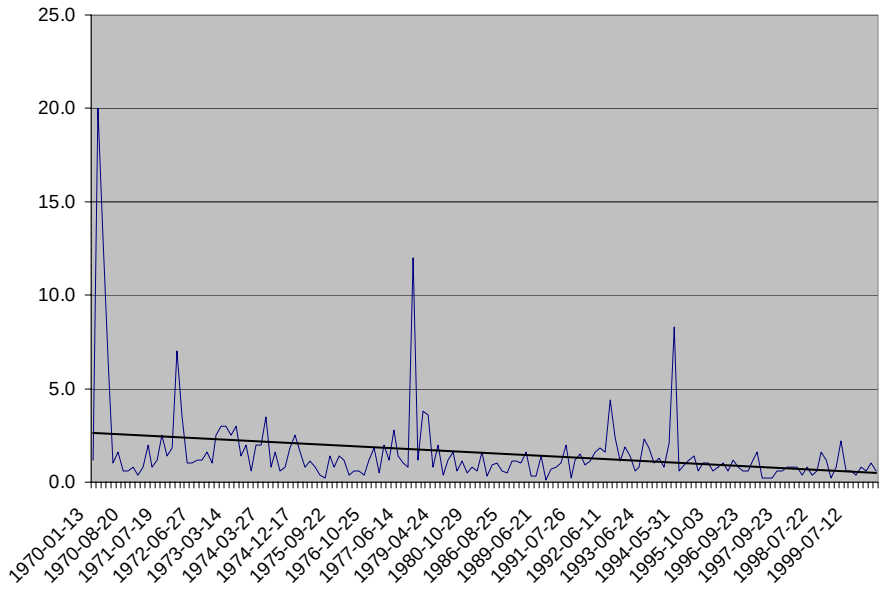

Figure 12. Biological Oxygen Demand at Hawkesbury (1970 - 2000).

Lake sturgeon spawn immediately downstream of Chaudière Falls, below Victoria Island. At one time, they spawned at the rapids near Hawkesbury but have abandoned this area after water levels increased from the construction of the Carillon Dam (Easton 1968). Numerous species such as largemouth bass, rock bass, carp, smelt, bluegill, black crappie, emerald shiner, brown bullhead, and pumpkinseed spawn in areas like Kettle Island Bay and Upper Duck Island Bay.

After the construction of the first dam at Carillon, fishing continued to excel, especially below the dam where the fish came to spawn and could not pass the barrier. American shad, lake sturgeon, and walleye are known to spawn downstream of the Carillon Dam. The annual run of shad provided local residents with a year's supply of fish. Fish merchants from Montreal would take the shad by means of large landing nets, dress and salt them into barrels for the Montreal market. Walleye were also taken in quantity. Sturgeon were often taken there but the best sturgeon waters extended from the Carillon Dam to Temiscaming.

There is diverse habitat throughout this reach necessary for spawning, nursery and rearing. Muskellunge are known to spawn in various wetland areas of the northern shore of the Ottawa River. Many of the tributaries on the Québec side have recently been documented as important for muskellunge spawning, but many of these are affected by urbanization, agriculture, and industry. Pike have also been documented spawning in wetland areas throughout the reach. Walleye are known to spawn below dams in tributaries and below the control structures at Chaudière Falls.

Generally the distribution and abundance of fish varies considerably among locations, with the most diverse fish communities found in the shallow, littoral areas. Based on gill netting catches, sauger are more abundant than walleye which is believed to be attributable to the high turbidity of this reach. Both largemouth and smallmouth bass populations appear stable and are most abundant in bays along the river. Little is known about the status of northern pike and muskellunge populations. There is reason to suspect that these stocks may be limited by the shortage of good spawning habitat, although reports from the Ottawa Valley chapter of Muskies Canada indicate that sizeable populations of muskellunge exist, with specimens up to 135 cm being caught. There is an active charter fishing industry, primarily for muskie, on this reach (Critchlow per comm[3]).

Brown trout have been stocked around the Ottawa-Hull area by local anglers' groups, but little increased fishing success has been noted.

In 2000, there were four commercial fisheries licensed from Ontario and three from Quebec in

[3] David Critchlow, Conservation Officer, Kemptville District.

Table 4. Fish species by reach of the Ottawa River.

Fish Species	Lac Dollard des Ormeaux	Lac Deschenes	Lac des Chats	Lac du Rocher Fendu	Allumette Lake and Lac Coulonge	Holden Lake	Lac la Cave
Channel catfish	X	X	X	X	X	X	
Brown bullhead	X	X	X	X	X	X	
Shorthead redhorse	X	X	X	X	X	X	
River redhorse	X	X	X	X	X		
Walleye	X	X	X	X	X	X	X
Sauger	X	X	X	X	X	X	X
Largemouth bass	X	X	X	X	X		
Smallmouth bass	X	X	X	X	X	X	X
Rock bass	X	X	X	X	X	X	X
Yellow perch	X	X	X	X	X	X	X
Northern pike	X	X	X	X	X	X	X
Muskellunge	X	X	X	X	X		
Common white sucker	X	X	X	X	X	X	X
Pumpkinseed	X	X	X	X	X		
Lake sturgeon	X	X	X	X	X	X	
Longnose gar	X	X	X	X	X		X
Black crappie	X	X	X		X		
Fallfish	X	X	X		X	X	X
Lake whitefish			X		X	X	X
Lake trout					X	X	X
Lake herring	X	X			X		X
Burbot	X	X	X		X		X
Mooneye	X	X	X	X	X	X	X
American eel	X	X	X				
Bluntnose minnow			X				
Emerald shiner	X	X	X	X	X	X	X
Carp	X	X					

this reach of river. Species licensed for harvest include bullhead, sunfish, yellow perch, suckers, carp, channel catfish, white perch, freshwater drum, black crappie, rock bass, and American eel. The harvest of eel by Ontario commercial harvesters was estimated at 295 kilograms (kg) in 1999 (Critchlow 2000) and 69 kg in 2000 (OMNR unpublished data). Eels are still being sampled in netting projects (Appendix 1). The commercial fishery for lake sturgeon was suspended in this reach of river in 1990 due to a decline in abundance and high contaminant levels. Recent netting studies have sampled an increased number of juvenile sturgeon in their nets.

A season-long creel survey has never been completed on this section of the river, although several seasonal angler surveys have been conducted on portions of this reach. It is estimated that from 25–30,000 angler days of effort are expended on the Québec portion of the river each year. Approximately one third of the annual fishing pressure occurs during the winter. On the Ontario portion it has been estimated that there are some 20,000 angler-days of effort per year. The winter effort mirrors that of Québec, with 350 ice huts being registered in 1992.

Wildlife

At least 27 water birds[4] (including the black tern) and seven raptors have been previously reported to breed in this reach of the river (Table 5) (Cadman et al. 1987).

Some of the best migratory bird habitat on the Ottawa River is located in this section of river between Montebello and Gatineau (Gaffield 1997; SFEP 2001). Species include the black duck (most abundant), northern pintail, northern shoveler, green-winged teal, blue-winged teal, wood duck, and American wigeon. Brewery Creek located across from the Gatineau River was once known for its variety of unique birds. As well, Kettle Island has been known for its blue herons, kingfishers, and diversity of ducks, which use the submergent vegetation, found along the north side of the island. Likewise, Lower Duck Island and marshes on the north side of the river attract numerous waterfowl (McKeating 1990). Ducks Unlimited is involved in management of wetlands in Baie de Lochaber, Baie Clement and Lac McLaurin (SFEP 2001).

Large spring migrations of Canada geese, as well as diving ducks (e.g. merganser, goldeneye, and scaup), dabblers (e.g. black duck, mallard, northern pintail, northern shoveller, wood duck, and teal) and even some snow geese, use the Reserve Faunique de Plaisance (Club des Ornithologues de l'Outaouais 2000). Rails, herons, least bitterns and dabblers have been reported in nearby Thurso Marsh (Sankey 1987). Other concentrations of Canada geese in this reach include Baie des Arcands, Baie de la Penetecote, Baie Noire, Baie Lochaber (SFEP 2001), and Voyageur Provincial Park (Critchlow pers comm.)

Of interest is a waterfowl habitat study conducted by Munro (1967) prior to and up to four years after impoundment behind Carillon GS. It was noted that by 1965 the aquatic vegetation appeared to have stabilized in broad zones as follows: grasses and sedges up to 0.3 m depth, Canadian waterweed and scarlet and amphibious knotweeds in depths between 0.3 and 1.3 m and scarlet knotweed in depths of 1.3–1.6 m. Munro noted that the abundance of breeding waterfowl in this reach increased following impoundment in direct relation to the degree of interspersion of emergent vegetation and small bodies of open water near loafing spots. Duck hunting is popular in this reach of river (Critchlow per comm.)

Numerous muskrat colonies can be found in this reach between Plaisance and Gatineau, e.g. Baie de la Penetecote, Baie Parisien, Baie Noire, Baie Daragon, Baie Lochaber, Baie Clement, Lac McLaurin and Kettle Island (SFEP 2001).

[4] Water birds comprises all species dependent on water i.e. grebes, herons, geese, ducks, rails, sandpipers and gulls.

Table 5. Breeding bird species by river reach.*

Bird Species	Lac Dollard des Ormeaux	Lac Deschenes	Lac des Chats	Lac du Rocher Fendu	Allumette Lake and Lac Coulonge	Holden Lake	Lac la Cave
Common loon		X			X	X	
Pied-billed grebe	X	X	X	X	X		
Double-crested cormorant		X					
American bittern		X	X		X		
Least bittern		X					
Great blue heron	X		X	X	X		
Green-backed heron	X	X	X		X		
Canada goose	X	X	X		X	X	
Wood duck	X	X	X		X	X	
Green-winged teal	X	X	X				
American black duck	X	X	X		X	X	
Mallard	X	X	X	X	X	X	
Northern pintail	X	X	X				
Blue-winged teal	X	X	X	X	X	X	
Northern shoveler	X	X			X		
Gadwall	X	X					
American wigeon	X	X			X		
Ring-necked duck		X			X		
Lesser scaup		X					
Hooded merganser	X	X			X	X	
Common merganser		X	X		X	X	X
Red-breasted merganser					X		
Osprey	X	X	X	X	X	X	
Bald eagle		X			X	X	
Northern harrier	X	X	X		X		
Sharp-shinned hawk	X	X	X				X
Cooper's hawk			X	X	X		

*Includes confirmed or probable breeding of raptors and bird species which depend on the river and its wetlands.

Table 5. Breeding bird species by river reach—continued.*

Bird Species	Lac Dollard des Ormeaux	Lac Deschenes	Lac des Chats	Lac du Rocher Fendu	Allumette Lake and Lac Coulonge	Holden Lake	Lac la Cave
Broad-winged hawk	X	X			X	X	X
Red-tailed hawk	X	X	X	X	X		X
American kestral	X	X	X	X	X	X	
Merlin		X	X		X		
Peregrine falcon			X		X		
Virginia rail		X	X	X	X		
Sora	X	X	X	X	X		
Moorhen	X	X	X		X		
Spotted sandpiper	X	X	X	X	X	X	
Upland sandpiper	X	X			X		
Common snipe	X	X	X	X	X		
American woodcock	X	X	X		X	X	
Wilson's phalarope		X					
Ring-billed gull		X	X		X		
Herring gull			X		X		
Great black-backed gull						X	
Common tern	X	X	X	X	X		
Black tern	X						
Belted kingfisher	X	X	X	X	X	x	
Purple martin		X	X	X	X		
Tree swallow	X	X	X	X	X	X	X
Bank swallow	X	X	X	X	X	X	X
Cliff swallow	X	X	X	X	X	X	X
Marsh wren		X	X		X		
Sedge wren					X		

*Includes raptors and bird species which depend on the river and its wetlands.

Source: Cadman et al. 1987

Twenty-seven amphibians and reptiles have been reported in this reach (Table 6) (Oldham and Weller 2000) in addition to an introduced species, the red-eared slider (Critchlow per comm).

Unique species

Two threatened, two vulnerable and one endangered species have been reported in this reach (Table 7) (OMNR 2001a).

Wetlands, parks, and environmentally sensitive areas

There are sixteen provincially and locally significant marshes found between Carillon GS and Gatineau, e.g. at Hawkesbury, Hamilton Island, Cunninghan Bay, Rockland and Duck Island (Table 8). The predominant vegetation in these marshes is cattail (*Typha* sp.). Due to the limited spring water level increases and abundance of cattail, many of these marshes are of only limited value for fish spawning habitat. A number of these marshes have been developed to increase waterfowl production.

Six Areas of Natural and Scientific Interest (ANSI) are located in this reach of the river (Table 9) (OMNR 2001a). They include four life science ANSIs at the Baie Lafontaine Islands, Petrie Island, Green Creek Conservation Area and Duck Islands; and two earth science ANSIs at Voyageur Provincial Park and Rockland. A parc de conservation, which is similar in importance to a national park, is located in Plaisance (SFEP 2001).

Shoreline development

The cities of Ottawa and Hull are located in the upstream portion of this reach. There are various towns, including Cumberland, Rockland, Gatineau, Hawkesbury and Grenville, along the shore of the river. Ottawa has a long history of settlement with an ancient aboriginal settlement located in Parc du Lac Leamy on the Gatineau River. Since 1961 some communities have experienced a decline in population, e.g. Carillon, while others have increased in size, e.g. Hawkesbury and Rockland (Ontario Water Resource Commission and Quebec Water Board 1972; Statistics Canada 2001) (Table 10).

Four pulp and paper mills, including J. MacLaren in Thurso and Masson, Canadian International Paper in Gatineau and E.B. Eddy Paper in Hull, currently operate along the north shoreline in this section of river. Eddy discontinued its pulping operations in 1972 (Environment Canada et al. 1985). Canadian International Paper closed down its mill in Hawkesbury in 1982 (Environment Canada et al. 1985). Log drives ceased in this section in 1990. This reach of the river, e.g. Hawkesbury, has been historically used for pulp and paper mills, lumber mills, waterworks and electrical generation (Denis and White 1911).

In comparison to the whole Ottawa River watershed, agricultural land use in the watershed of this reach is quite high, e.g. 77% of the South Nation River sub-basin, as are built-up areas, e.g. 2.4% of the Rideau River sub-basin (Table 11) (Telmer 1996).

Lac Deschênes (Chaudière Falls to Chats Fall/ Fitzroy)

Pre-development description

Historically, Chaudière Falls was a place of ceremony, where natives threw tobacco into the falls in belief that they would be protected from their enemies (Kennedy 1970). This was an area where the river tumbled over a limestone ledge (Figure 13) in a series of channels between islands (Hughson and Bond 1964). The falls consisted of seven rapids that poured into the deep kettle with such tremendous force that it gave the appearance of boiling water (Figure 14) (Mika and Mika 1982). Early accounts of the falls include:

> *"the scenery of Chaudière Falls before it was defaced was truly picturesque, almost indescribably grand. The rocky cliffs, green with the cedars and the pines to the rivers brink, its volume of water tossed broke, dashed into foam, that foam floating down like islands of pearl on the bosom of the dashing current, the whole surveyed*

Table 6. Amphibians and reptiles by river reach.

			Lac Dollard des Ormeaux	Lac Deschenes	Lac des Chats	Lac du Rocher Fendu	Lac Coulonge	Lower Allumette	Allumette Lake	Holden Lake	Lac la Cave
Amphibians	Frogs	American toad	X	X	X	X	X	X	X	X	X
		Spring peeper	X	X	X	X	X	X	X	X	
		Western chorus frog	X	X	X	X		X	X		
		Gray treefrog	X	X	X	X	X	X	X	X	
		Wood frog	X	X	X	X	X	X	X	X	
		Northern leopard frog	X	X	X	X	X	X	X	X	
		Walleye frog		X					X		
		Green frog	X	X	X	X	X	X	X	X	
		Mink frog		X	X				X	X	
		Bullfrog	X	X	X	X	X	X	X		
	Salamanders	Common mudpuppy	X	X	X		X				
		Red spotted newt	X	X	X						
		Jefferson salamander complex	X	X	X	X	X	X	X	X	X
		Spotted salamander	X	X						X	
		Northern two-lined salamander	X	X	X	X					
		Four-toed salamander	X								
		Northern redback salamander	X	X	X				X		

Table 6. Amphibians and reptiles by river reach—continued.

			Lac Dollard des Ormeaux	Lac Deschenes	Lac des Chats	Lac du Rocher Fendu	Lac Coulonge	Lower Allumette	Allumette Lake	Holden Lake	Lac la Cave
Reptiles	Snakes	Eastern garter snake	X	X	X	X	X	X	X	X	X
		Eastern ribbon snake	X					X			
		Northern water snake	X	X					X	X	
		Northern redbelly snake	X	X	X			X	X		X
		Smooth green snake	X	X					X		
		Northern ringneck snake	X						X	X	
		Eastern milk snake	X	X	X		X	X	X		
	Turtles	Common snapping turtle	X	X	X	X	X	X	X	X	
		Common musk turtle	X	X	X						
		Midland painted turtle	X	X	X	X	X	X	X	X	
		Common map turtle	X	X	X	X	X	X	X		
		Blanding`s turtle	X	X	X	X	X	X	X		
		Wood turtle					X		X		
		Eastern spiny softshell					X	X	X		

Source: Oldham and Weller 2000; Coulson pers comm.

Table 7. Unique plant and wildlife species by river reach.

Reach	Species	
Lac Dollard des Ormeaux	Cutlips minnow (T*) Eastern spiny softshell turtle (T) Northern brook lamprey (V)	Peregrine falcon (E) River redhorse (V)
Lac Deschênes	Braun's quillwort Floating heart *Najas flexilis* *Potamogeton perfoliatus* *Potamogeton pusillus* *Potamogeton robbinsii* *Potamogeton spirillus* Water crowfoot Water stargrass	Barrow's goldeneye Least bittern (V) Red-shouldered hawk (V) River redhorse (V) Ruddy turnstone Snow goose Tremblay's salamander
Lac des Chats	Grasshopper sparrow Red-shouldered hawk (V)	River redhorse (V)
Lac du Rocher Fendu	Rams head lady slipper	
Allumette Lake and Lac Coulonge	Bald rush Douglas buckwheat Sand heather Smith's club-rush Torrey's bulrush	Bald eagle Eastern spiny softshell turtle (T) Peregrine falcon (E) Wood turtle

*Species is vulnerable (V); threatened (T); or endangered (E) as per Ontario Endangered Species Act and COSEWIC 2001
Source: Envirocon Ltd/Proctor & Redfern Ltd. 1979; Jolicoeur 1992; OMNR 2001a

> *from the brow of the hills on the east in the evening sun, to be comprehended, to be esteemed, to be capturously admired, must be dwelt upon. Thus Samuel Champlain saw it, Mirrick and Stevens saw it, thus Philemon Wright saw it before a tree was removed or an arched has spanned it except the rainbow in its natural grandeur, in its virgin beauty, in its pristine sublimity. This is much the finest falls on the river"* (Gourlay 1896).

As described by Champlain:

> *"the water falls…impetuosity on a rock that with the passage of time it has hollowed out a wide, deep basin. This water falls makes such a noise in the basin that one can hear it from more than two leagues away"* (Kennedy 1970).

Figures 13 and 15 illustrate the rock ledges that were present at Chaudière Falls. Figure 14 gives an indication of how the falls appeared during high water flows before the dams were constructed. Alterations at Chaudière Falls occurred early in settlement. The first industries, a grist mill and a saw mill driven by waterwheels, were established in 1802 at the Chaudière Falls (Hughson and Bond 1964). The first log slide was built at this location in 1829, and a second one built on the south side in 1836 (Hincks 1978). A diversion dam, approximately 45.7 m long and 4.6 m high, was

Table 8. Wetlands by river reach.

River Section	Wetland	Significance
Lac Dollard des Ormeaux	Duck Island Wetland	Provincially significant
	Petrie Island Wetland	Provincially significant
	Baie Lafontaine Wetland	Provincially significant
	Wood Street Swamp	Locally significant
	Lafontaine River Marsh	Locally significant
	Rockland Marsh	Provincially significant
	Clarence Island Marsh	Provincially significant
	Parker Island Marsh	Provincially significant
	Cunningham Bay Wetland	Locally significant
	Chenier Bay Wetland	Locally significant
	McGowan Point Marsh	Locally significant
	Azatica Bay	Locally significant
	Hamilton Island Marsh	Locally significant
	Hawkesbury Marsh	Locally significant
	Dollard des Ormeaux Marsh	Locally significant
	Carillon Marsh	Provincially significant
Lac Deschênes	Constance Creek Wetland	Provincially significant
	Shirley's Bay Wetland	Provincially significant
	Mud Lake Wetland	Provincially significant
Lac des Chats	Bonnechere Rivermouth Wetland	Provincially significant
	Nopoming Wetland	Provincially significant
	Morris Island Wetland	Provincially significant
	Mississippi Snye Wetland	Provincially significant
Allumette Lake and Lac Coulonge	Hales Creek Wetland	Provincially significant (?)
	Hazley Bay/Lisk Bay Complex	Provincially significant
	Bellow's Bay Wetland	Provincially significant
	Hennessy's Bay Wetland	Provincially significant (?)
	Malloy Bay Wetland	Provincially significant (?)
	Lacroix Bay Wetland	Provinicially significant (?)

Source OMNR 2001a

constructed halfway down the channel. A flume 201 m long, 1.8 m deep and 30.2 m wide tapering to 6.1 m wide was built from this structure down the north side of Victoria Island to service water-lots. A similar flume was built on Chaudière Island (Hughson and Bond 1964). In 1868, a diversion dam 106.7 m long and 22.9 m wide at the base was constructed across Chaudière Falls to allow for continuous supply of water to the mills. This structure was built of strong crib-work filled with stone, faced with heavy planks, and braced with iron. This structure was later replaced by a larger structure in 1896 (Hughson and Bond 1964). In the 1890's, two small power plants were built at Chaudière Falls to supply industrial and residential power to Ottawa (Hincks 1978). The *Ring Dam* was constructed in 1909 (Tremblay et al. 1970).

Despite the dam at Chaudière Falls, Lac Deschênes is still the same beautiful stretch of water that was observed by early travelers (Legget 1975); the shoreline remains relatively unaltered due to the construction of hydraulic structures (Ottawa River Engineering Board 1965).

Table 9. Environmentally sensitive areas by river reach.

River Section	Environmentally Sensitive Area
Lac Dollard des Ormeaux	Parc de Conservation de Plaisance
	Voyageur Provincial Park Earth Science ANSI
	Rockland Precambian Earth Science ANSI
	Baie Lafontaine Islands Candidate Life Science ANSI
	Petrie Island Wetland Candidate Life Science ANSI
	Green Creek Conservation Area Life Science ANSI
	Duck Islands Candidate Life Science ANSI
Lac Deschênes	Britannia Conservation Area Candidate Life Science ANSI
	Ottawa Beach Wetland Candidate Earth Science ANSI
	Shirley's Bay Wetland Earth Science ANSI
	Constance Creek Wetland Life Science ANSI
	Horseshoe Bay Shores Candidate Life Science ANSI
	Constance Bay Sandhills Earth Science ANSI
	Fitzroy Provincial Park
Lac des Chats	Mississippi Snye Wetland Life Science ANSI
	Morris Island Conservation Area Life Science ANSI
	Projet du Refuge Faunique de Bristol
Lac du Rocher Fendu	Provincial Waterway Park
Allumette Lake and Lac Coulonge	La Passe Pipeholes Earth Science ANSI
	Petawawa Terrace Life Science ANSI
	Ruisseau de l'Indien RPF*
	James Little RPF
	De l'Aigle à Tête Blanche RPF
Holden Lake	André Linteau RPF
	Driftwood Bay Provincial Park
Lac la Cave	Alexander Lake Forest Life Science ANSI
	Jocko/Ottawa River Earth Science ANSI
	Colton Narrows Life Science ANSI
	Pinetree Point Life Science ANSI

*RPF is a Quebec designated project de reserve ecologique. A reserve ecologique is given the highest level of protection in Quebec

Source OMNR 2001a; SFEP 2001

Existing physical description

Lac Deschênes, the reach of river between Chaudière Falls and Chats Falls, is 52.8 km long and has a surface area of 10,900 ha. The cities of Ottawa and Hull are the most prominent features on this reach. There are several natural sets of rapids remaining in this reach close to Ottawa and Hull including Deschênes Rapids, Remic Rapids and Little Chaudière Rapids. The Québec shoreline is characterized by depths of less than 2 m and extensive sections of wetlands. Water depths are generally less than 9.0 m; however, there is a deep trough between Twelve Mile Island and Aylmer Island that reaches depths of 49 m.

The Chaudière Dam (Figures 16 and 17) maintains a constant water level for power generation at Hull 2, E.B. Eddy (intakes located on the north end of the dam) and four hydro plants at the southern end of the dam. Additional characteristics of the Hull 2 GS are outlined in Table 2. The dam has 50 gates to control water levels (Abdelnour et al. 2000). However, the dam controls very little water and has no storage capacity (Ottawa River Regulation Planning Board 1987).

Table 10. 1961 and 1996 populations by river reach.*

Reach	Town/City	1961	1996	% Change
Lac Dollard des Ormeaux	Carillon	427	258	-40
	Hawkesbury	8661	10,162	+17
	Rockland	3037	8070	+165
Lac Deschênes	Hull	56,929	62,339	+10
	Ottawa	303,395	542.462	+79
Lac des Chats	Arnprior	5474	7113	+30
Lac du Rocher Fendu	Campbells Bay	1024	874	-15
	Bryson	537	753	+40
Allumette Lake and Lac Coulonge	Fort Coulonge	1823	1716	-6
	Pembroke	16,791	14,177	-16
	Petawawa	4509	6540	+45
	Deep River	5377	4491	-35
Holden Lake	Mattawa	3314	2281	-31

*Comparison between years may be somewhat off due to changes in community boundaries.

Source: Telmer 1996

This portion of the river has a total of 21 relatively small tributaries (11 in Québec and 10 in Ontario) (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). The largest tributaries are the Mississippi Snye (which currently has a very small discharge) and Constance Creek in Ontario and the Quyon River in Québec. The mean annual discharge of selected tributaries is described in Table 3.

Table 11. Mean percentage of land use class per tributary sub-basin of the Ottawa River.

Reach	Tributary	Area of sub-basin (km2)	% Forest	% Agriculture	% Built-up area	% Open water
Lac Dollard des Ormeaux	Rideau	4232	34.6	59.3	2.4	3.7
	Gatineau	24581	92.2	2.1	0.2	5.6
	Lievre	10650	94.2	3.6	0.1	2.1
	Petite nation	2717	91.5	5.8	0.0	2.8
	South Nation	5697	22.7	77.0	0.0	0.3
	Rouge	7977	95.6	3.6	0.3	0.2
Les des Chats	Bonnechere	4662	79.1	18.8	0.0	2.1
	Madawaska	9094	96.5	0.9	0.0	2.6
	Mississippi	4632	71.0	27.1	0.1	1.8
Allumette Lake/Lac Coulonge	Petawawa	4402	97.3	0.2	0.0	2.5
	Noire	2744	96.4	1.5	0.0	2.1
	Coulonge	5406	98.5	0.6	0.0	0.9
Holden Lake	Mattawa	5827	97.6	0.0	0.6	1.8
	Dumoine	4483	96.3	0.0	0.0	3.7

Source: Telmer 1996

Figure 13. The rock ledges of Chaudière Falls during low water in the 1870's (National Archives of Canada PA 12517).

Figure 14. Chaudière Falls during high water in 1909 (National Archives of Canada PA 9415).

Figure 15. A view of Chaudière Falls during the 1900's (National Archives of Canada PA 139335).

Figure 16. Aerial view of Chaudière Falls in the mid 1900's (National Archives of Canada PA 44397).

Figure 17. Control dam at the head of Chaudière Falls (2000).

There are few islands in this portion of the river. The river bottom is covered with gravel and rubble/boulder in rapid sections (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). In slow flowing sections above Chaudière Dam, the river bottom is covered with sand over a clay substrate.

Present hydrology

Water levels fluctuate in Lac Deschênes approximately 0.9 m annually, with the high on average of 58.8 m occurring during the spring freshet and the low on average of 57.9 m occurring during September (Figure 18). Since the dam at Chaudière

Falls controls very little water, levels are affected strictly by the flows being passed from upstream.

Waters are slow flowing except immediately below the dam at Chats Falls and the areas of natural rapids between Aylmer and Chaudière Falls (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999).

Chemical characteristics

Water surface temperatures mid summer in this reach are approximately 24°C (RMOC 1999). The water column does not thermally stratify completely because of the strong currents. The water colour in this portion of the river is brown (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). Transparency varies from 1.8 to 3.5 m. Conductivity is average for the region and varies from 52 to 63 micro ohms per cm (µhos/cm). The pH is 7.5.

Water quality in this area is good with low levels of toxic organics, trace metals, phosphorous and nitrates (Environment Canada et al. 1985). The maximum phosphorus levels are 0.01–0.02 mg/l (RMOC 1999). Current levels of metals are outlined in RMOC (1999).

Natural environment

Fisheries

This reach supports a relatively diverse warmwater/coolwater fish community with at least 57 species documented in this reach (Appendix 1). Walleye, northern pike, smallmouth bass, muskellunge, and yellow perch are the major sport fish species (Table 4). Channel catfish, longnose gar, and suckers are regarded as the most abundant fish species. Other species of lesser abundance in this section of the river include sauger, largemouth bass, brown trout, bullheads, crappies, rock bass, burbot, pumpkinseed, mooneye, and sturgeon.

An Envirocon Ltd/Proctor & Redfern Ltd. (1979) study of the Chats Falls area found 19 fish species with minnows, perch, and catfish being the prevalent species. Other fish species which have been observed in the Chats Falls GS tailrace and sluices include smallmouth and largemouth bass, silver and shorthead redhorse, walleye, northern pike,

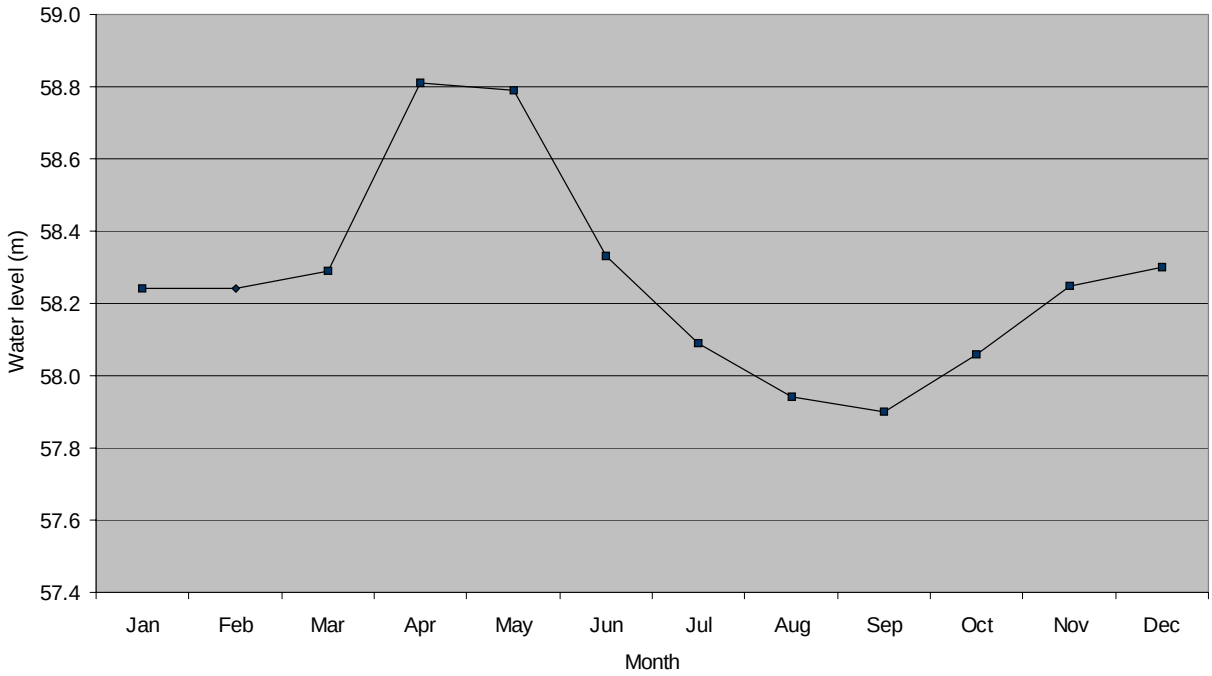

Figure 18. Mean monthly water levels of Lac Deschênes over the past 50 years.

and muskellunge (Niblett Environmental Associates Inc. 1990). Ontario Hydro staff reported eels at Chats Falls GS (Chubbuck 1993), however, the numbers of eels observed annually have been declining. Eels were last sampled in netting efforts in 1989 (Appendix 1).

Lake sturgeon spawn downstream of the generating station. A study in 1949 sampled over 400 spawning lake sturgeon. Numbers of sturgeon in this reach of river have declined. A survey of the same spawning area in 2001 yielded only eight sturgeon. Recruitment is considered to be a limiting factor in this reach of the river (Haxton in review).

The Deschênes Rapids is an area in which species such as walleye, smallmouth bass, rock bass, mooneye, suckers, channel catfish, sauger, and mottled sculpins are known to spawn. Areas such as Britannia Bay support spawning northern pike, rock bass, longnose gar, silvery minnow, spottail shiner, brown bullhead, and pumpkinseed.

Traditionally there was one commercial fisherman licensed by Ontario but this licence has been inactive since 1988 (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). Presently there are three active Ontario baitfish licences issued for baitfish harvest in this section of the river. There is a commercial fishery for lake sturgeon licences out of Québec in the Quyon area with a quota of 0.1 kilogram per hectare (kg/ha) of Quebéc waters.

A season long creel survey has not been completed for this section of the river although several seasonal angler surveys have been conducted on portions of this reach (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). In the Québec portion of this section of the river, fishing effort has been estimated at approximately 15,400 angler days per year. At least 40% of this effort is exerted in the section of the rapids adjacent to Ottawa-Hull. The only creel data for the Ontario waters were collected in the winter of 1989 and for the mid-summers of 1978 and 1981. It was estimated that 18,000 angler days of effort were expended that winter, while summer pressure was estimated at about 2,500 angler days. The main species in the catch included walleye, bass, pike, and channel catfish.

Wildlife

At least 38 water birds (including the ring-necked duck, lesser scaup and Wilson's phalarope) and eight raptors have been previously reported[5] to breed in this reach of the river (Table 5) (Cadman et al. 1987).

Similar to Lac Dollard des Ormeaux, migrating waterfowl species also concentrate in this reach especially such areas as Twelve Mile Island, Baie Noire, Mohr Island, Baie Pontiac and Fitzroy Harbour (SFEP 2001). For example, over 20,000 waterfowl, particularly dabbling ducks have been known to visit Baie Noire in the spring (Sankey 1987). Canada geese are reported to nest on small islands in this reach of the river (Club des Ornithologues de l'Outaouais 2000). Shorebird species are limited by the availability of shoreline habitat.

The best waterfowl habitat in this reach is located more than 20 km downstream at Shirley's Bay/ Britannia Bay. Large numbers of waterfowl, e.g. Canada geese, loons, grebes, scoters, long-tailed duck, snow geese, brant, the rarer greater white-fronted goose, and Richardson's geese, redhead, canvasback, common goldeneye, and numerous dabbling ducks congregate in Britannia Bay in the spring and in the fall (Bracken and Lewis 2000; Finlay 2000). Thirty-five shorebird species have been sighted on the sand flats here (Britannia Bay to Andrew Hayden Park; McKeating 1990) including the American golden plover, whimbrel, red knot, western sandpiper, purple sandpiper, piping plover, willet, buff-breasted sandpiper, red phalarope, the rarer spotted redshank, Iceland, lesser black-backed and glacous gulls, the rarer mew gull, and the rarer black-legged kittiwake. Other species such as arctic tern, Bonaparte's gull,

[5] Confirmed or probable breeding.

Barrow's goldeneye, harlequin duck, common loon, black tern, and thick-billed murre have been sighted in the Deschênes rapids just downstream of Britannia Bay (Bracken and Lewis 2000; Finlay 2000).

Common goldeneye and common mergansers are reported to winter in the open waters around Bate Island and Deschênes Rapids (McKeating 1990). In addition, loons, diving ducks and, often, bald eagles have been reported on the ice in early winter on Lac Deschênes (Sankey 1987). There is a possibility that black-crowned night herons nest on Mohr Island.

There are muskrat colonies located in the vicinity of Baie Breckenridge, Baie Noire, Baie Dion and Mohr Island (SFEP 2001).

Twenty-six amphibians and reptiles have been reported in this reach (Table 6) (Oldham and Weller 2000).

Unique species

There have been a number of unique or less common species in this reach of the river. An Envirocon Ltd/Proctor & Redfern Ltd. (1979) study found five waterfowl and shorebird species (Barrow's goldeneye, double-creasted cormorant, least bittern, ruddy turnstone, and snow goose), one amphibian species (Tremblay's salamander) and one reptile species (northern ribbon snake) in the area downstream of Chats Falls GS (Table 7). Three vulnerable species, i.e. red-shouldered hawk, least bittern, and river redhorse have been reported in this reach (OMNR 2001a).

Nine uncommon aquatic plant species are located in Pontiac Bay just downstream of Chats Falls GS. They include floating heart, Braun's quillwort, *Najas flexilis, Potamogeton perfoliatus, Potamogeton pusillus, Potamogeton robbinsii, Potamogeton spirillus,* water crowfoot, and water stargrass (Table 7).

Wetlands, parks, and environmentally sensitive areas

There are three provincially significant marshes found in this reach of the river at Mud Lake, Shirley's Bay and Constance Creek (Table 8) (OMNR 2001). Other wetlands are located at Baie Breckenridge, Baie Noire, Mohr Island, Woolsey Narrows, Pointe Hudson, Kedey's Island and Pontiac Bay (SFEP 2001).

There are six ANSIs in this reach: three life science ANSIs (Britannia Conservation Area, Constance Creek and Horseshoe Bay) and three earth ANSIs (Ottawa Beach, Shirley's Bay and Sandhills) (Table 9) (OMNR 2001a). Parks in this section of the river include Britannia Bay Park, Graham Bay Park and Fitzroy Provincial Park.

Shoreline development

The cities of Ottawa and Hull are the prominent features located at the lower end of this reach. Since 1961 these cities have experienced an increase, e.g. up to 79%, in population (Ontario Water Resources Commission and Quebec Water Board 1972; Statistics Canada 2001) (Table 10).

There are over one thousand households and cottages in this section of the river based on review of topographic and Ontario base maps. Aylmer (Québec) and the City of Nepean are municipalities that are found in this section of the river. Industries in this section include Goldie Mohr Construction and M.G. MacDonald. Log driving on this section of the river has been discontinued since the mid-1970s (Environment Canada et al. 1985).

Lac des Chats (Chats Falls/Fitzroy to Cheneaux Dam)

Pre-development description

The Chats Falls and Rapids were described as the most beautiful on the river, extending approximately 3.2 km in width. Total rise from the foot of the falls to Chats Lake was about 15.2 m (Ells 1901). Thirty independent chutes of every conceivable form comprised the rapids of Chats Falls (Legget 1975) with fifteen distinct falls averaging about 7.6 m in height (Sherriff 1831). Figure 19 offers an aerial view of this section of river from May 1927. Several accounts of the falls prior to the construction of the dam include:

> *"The next in importance is the Chats Rapids about thirty miles west of the Chaudière, observed from an eminence on the east side facing the falls, the rivers rocky bed is dotted with islands covered with ever green pine and divided into many channels forming great cascades, the rushing waters dashing over the precipitous rocks, foaming into the abyss below, filling the eye with the magnificence of the vision and the ear with the soft but thundering sound of many waters"* (Gourlay 1896).

As described by Alexander Henry, a fur trader in 1761:

> *" the ridge of rock crossed the stream and occasions not only one, but numerous falls separated from each other by islands, and affording a scene of a very pleasant appearance. At a distance of a mile, seven openings present themselves to the eye, along a line of two miles, at this point, is the breadth of the river. At each opening is a fall of water, of about thirty feet in height, and which, from the whiteness of its foam might be mistaken for a snowbank."* (Kennedy 1970)

The scenery was considered singular and beautiful (Sherriff 1831) and was a tourist attraction in the 1800s with the steamboat *"Lady Colborne"* touring boatloads of people to observe the falls (Kennedy 1970). Figures 20 to 22 illustrate the picturesque scenery these tourists would have experienced.

Alterations began at Chats Falls with the construction of a log slide in 1835 by G. Buchanan (Tremblay et al. 1970; Legget 1975). In 1854, the construction of a canal on the north side just under 4.8 km in length was initiated as a means of permitting navigation around the falls. However, due to the high costs, the canal was never completed and work ceased in 1856 (Legget 1975). This canal was eventually dammed upstream during the construction of the Chats GS (Kennedy 1970).

Chats Rapids were approximately 4.8 km upstream of the falls, immediately downstream from where the railway bridge crosses (Figure 23). The stone of these rapids is chiefly a soft, white, coarse gravel limestone (Sherriff 1831). These rapids were flooded after the construction of the Chats Dam.

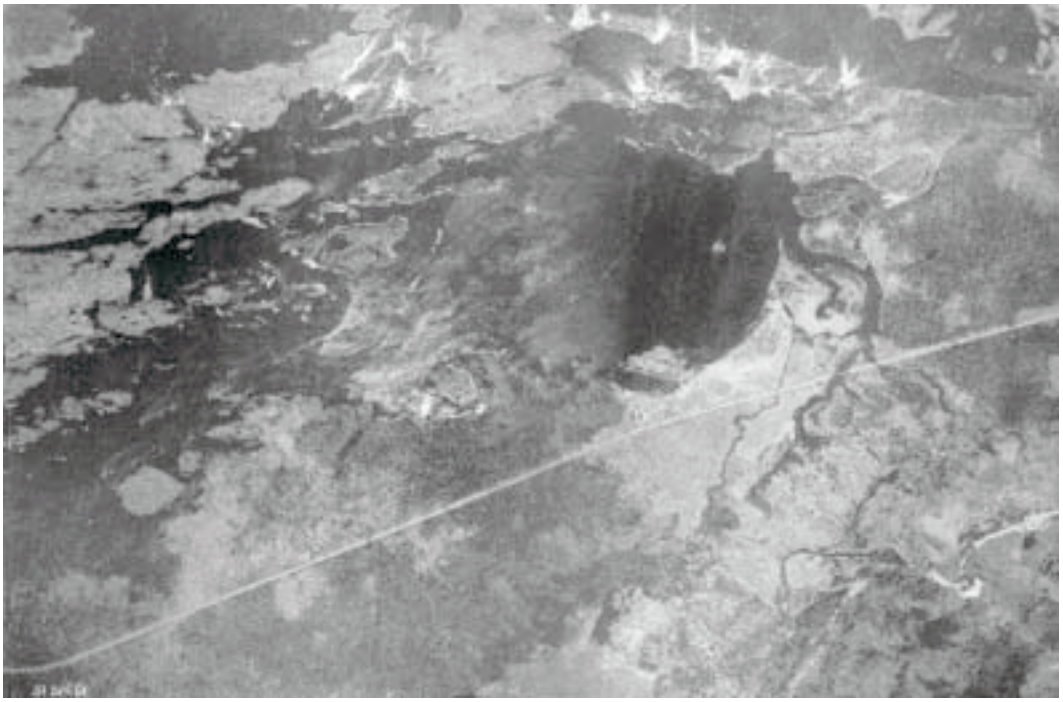

Figure 19. 1927 aerial view of Chats Falls (National Air Photo Library).

Figure 20. Mohrs Chute and Horseshoe Chute prior to the construction of Chats Generating Station (National Archives of Canada PA 9340).

Figure 21. Historical view of Ragged Chute at Chats Falls (National Archives of Canada PA 9336).

Figure 22. An historical view of the log chute at Chats Falls (National Archives of Canada PA 9330).

Figure 23. Aerial view of Chats Rapids and Chats Falls from upstream, 1920 (National Archives of Canada C22209).

Existing physical description

The Chats Falls site was permanently altered by the construction of the hydroelectric dam immediately upstream of the falls (Figure 24) (Table 2). Construction of the existing structure began in 1929, and it was operational by 1931 (Biggar 1991). The main generating station, 152 m in length (Biggar 1991) was constructed at Mohr's Chute (Figure 25). Additional features of Chats Falls GS are outlined in Table 2. Sluiceways were constructed at Ragged Chute, Horseshoe Chute and Conroy's Chute. Remnants of these channels still exist (Figures 26 to 29). The total length of the dam structure is 3700 m (Biggar 1991). In addition, an earth dyke 1375 m was constructed of clay and riprap (Biggar 1991). The difference in elevation in Lac des Chats and Lac Deschênes was 15.2 m, where originally the drop of the falls was 11.6 m. In order to obtain the additional generating head, water in Lac des Chats was raised to the normal high water level (Biggar 1991).

Lac des Chats is a 40 km long impoundment, extending from the Chats Falls GS to the Chenaux GS at Portage du Fort. The width of the river varies with a maximum of 3 km. The surface area of this impoundment is 7,513 ha. Most of this section is shallow with an average depth less than 10 m, and a maximum depth of 30 m (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). The only set of rapids remaining is below the tailrace at Chenaux Dam.

The main tributaries include the Mississippi River, Madawaska River and Bonnechere River. The mean annual discharge of selected tributaries is described in Table 3.

The Ontario shore is scalloped and punctuated by points (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). It has a gentle profile with variable shoreline substrates including sand, clay and gravel. Sand is abundant with softer sediments in protected embayments, i.e. behind the dam on Victoria

Figure 24. Aerial view of Chats Generating Station, July 1932 (National Archives of Canada C 22216).

Figure 25. Chats Generating Station, 2000.

Figure 28. Sluice gates and ancient waterway at Conroy's Chute, 2000.

Figure 26. Sluice gates and ancient waterway at Ragged Chute, 2000.

Figure 29. Current view of log chute at Chats Falls, 2000.

Figure 27. Sluice gates and structures at Horseshoe Chute, 2000.

Island, and deeper sections of the river. The Québec shoreline is much more irregular, marshy and dotted with islands. There is a concentration of islands 5 km below Chenaux GS.

Present hydrology

The drainage area of Chats Falls is 89,600 km^2. The mean annual discharge is 1,144 m^3/s, (Telmer 1996) rising at times of flooding to 6,230 m^3/s and falling as low as 350 m^3/s (Biggar 1991).

Water levels are maintained relatively consistent throughout the year with the exception of the 0.34 m increase on average during the spring freshet (Figure 30).

River flows are dependent on operations of the generating station and control structures at Chenaux. A flow of 350 m^3/s through Chats Falls GS, which is equivalent to two units in operation, is passed as base flow for Chaudière. Since Chats Falls headpond is relatively small, the requirement for baseflow is transferred upstream to Chenaux GS. Time of travel from Chenaux GS to Chats Falls GS is about two and a half hours.

The restrictions placed on Chats GS have a significant impact on Chenaux operations. Station operations at Chats Falls GS are tempered so that the water elevation at Britannia (Ottawa) does not fall below 57.80 m.

Chemical characteristics

According to an OMNR survey of water chemistry of Lac des Chats in August 1990, this reach of the river was not thermally stratified (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). The pH was found to be slightly alkaline.

Water quality in this area is good with low levels of toxic organics, trace metals, phosphorous and nitrates (Environment Canada et al. 1985). A 1979 study by Envirocon Ltd/Proctor & Redfern Ltd. found the water in the vicinity of Chats Falls GS to be relatively clean with moderate to high nutrient levels and some localized contaminated areas, i.e. Victoria Island. The river water is thoroughly mixed and well oxygenated. In the past, BOD levels sampled at Chat Falls GS have tended to range between 0.2 and 3.0 mg/l (Figure 31) and total phosphorus between 0.01 and 0.08 mg/l (Figure 32). Total Kjeldahl nitrogen levels measured between 1971 and 1984 at Chats Falls have averaged around 0.35 mg/l with highs of 1.12 mg/l (Telmer 1996).

Natural environment

Fisheries

Lac des Chats supports a diverse warmwater and coolwater fish community with at least 42 species

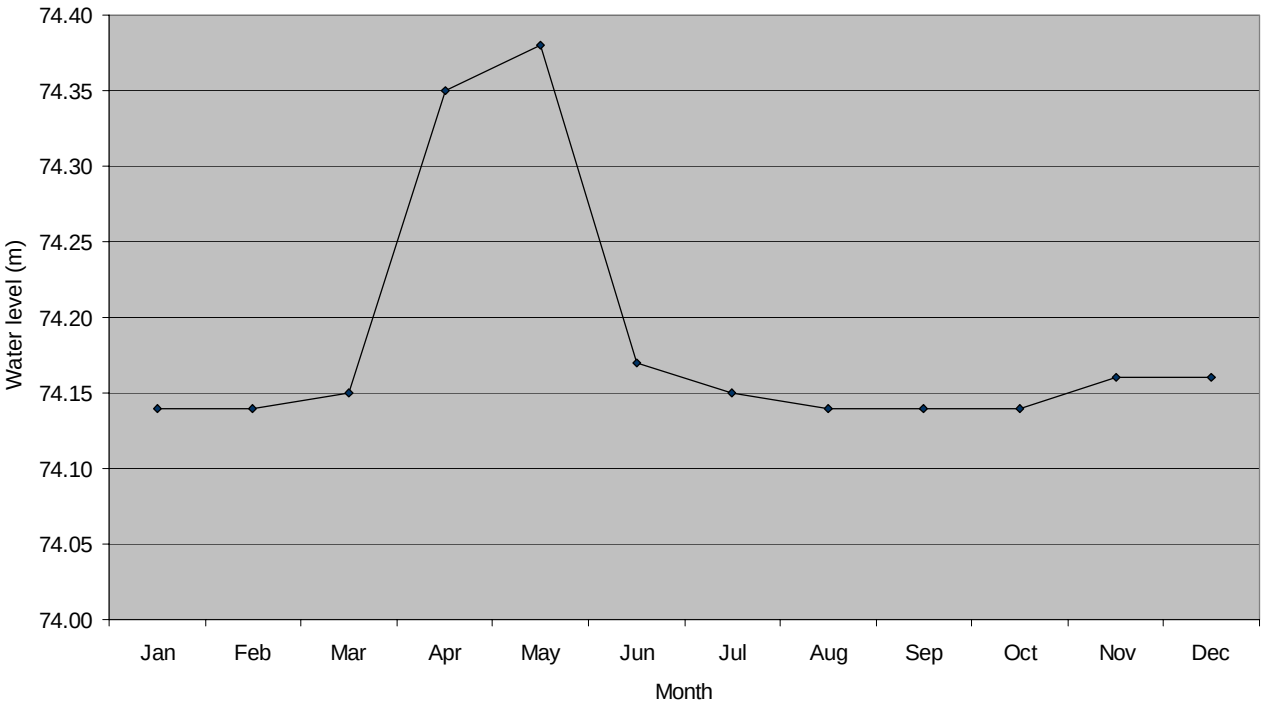

Figure 30. Mean monthly water levels of Lac des Chats over the past 50 years.

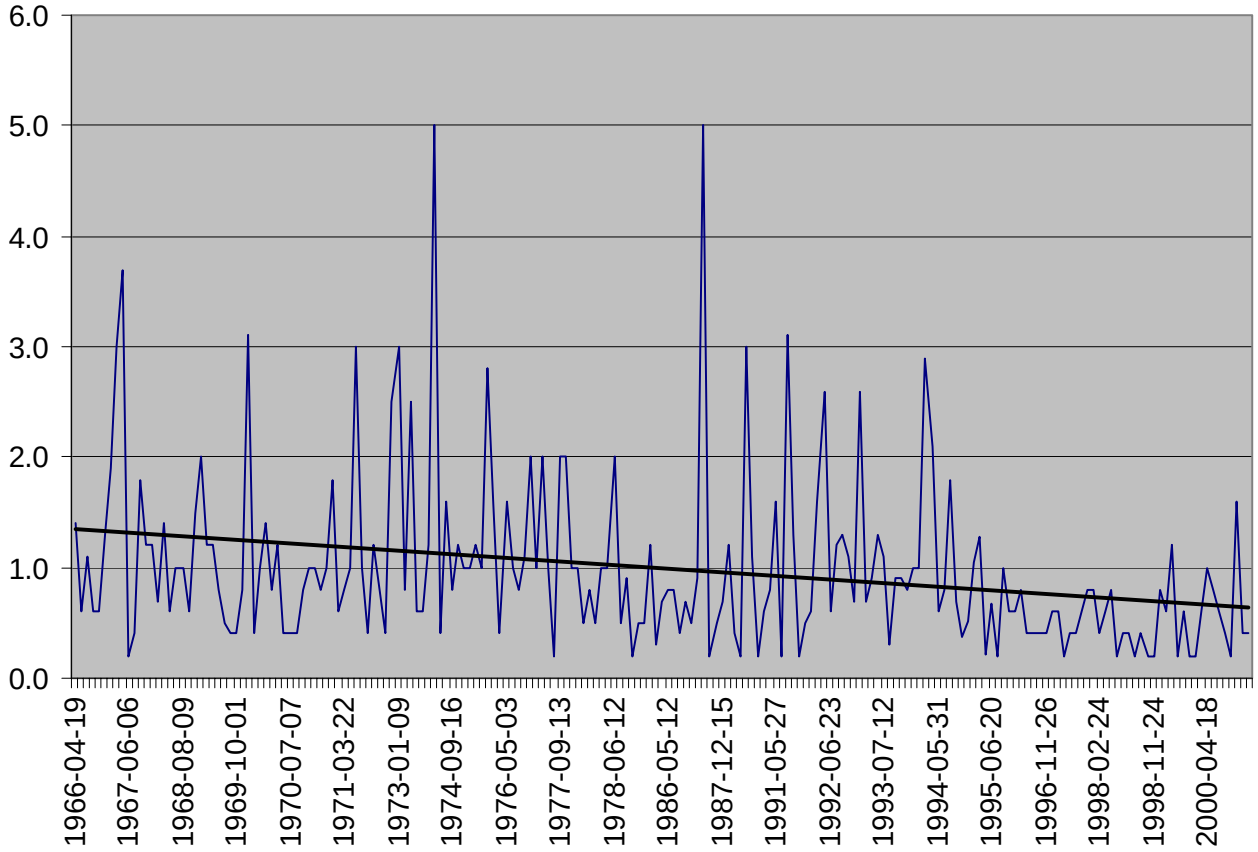

Figure 31. Biological Oxygen Demand levels at Chats Falls (1966-2001).

documented in this reach (Appendix 1). Walleye, smallmouth bass, northern pike, yellow perch, and muskellunge are the major game species in this reach (Table 3). Netting efforts have shown that channel catfish are the most abundant species in this reach of river (Haxton 1999). Other species prevalent include brown bullheads, yellow bullheads, redhorse species, and longnose gar. Lake sturgeon numbers are considered to be low in this reach and American eels are occasionally still sampled (Appendix 1).

An Envirocon Ltd/Proctor & Redfern Ltd. (1979) study of the Chats Falls area found 19 fish species with minnows, perch, and catfish being the prevalent species. Walleye spawn in the tailrace of Chenaux GS, below the weir in the Madawaska River, Galetta Dam in the Mississippi River, around the islands in the middle of the river and in the Bonnechere River. Pike spawn in Rhoddy's and Marshall Bays and the mouth of the Bonnechere River. Muskellunge have been documented spawning along the north shore of the river in this reach.

There is little fishing in the forebay due to access through the narrows upstream at Lavergne Point, but there is greater fishing pressure in back bays upstream of the Chats Falls Generating Station. Fishing pressure is not as great in the Braeside/ Arnprior area as in other areas.

The Arnprior Fish and Game Club conduct an annual opening day walleye creel census below the weir on the Madawaska River (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). Considerable angling occurs here and at the Chenaux tailrace during the early season. There have been some complaints from

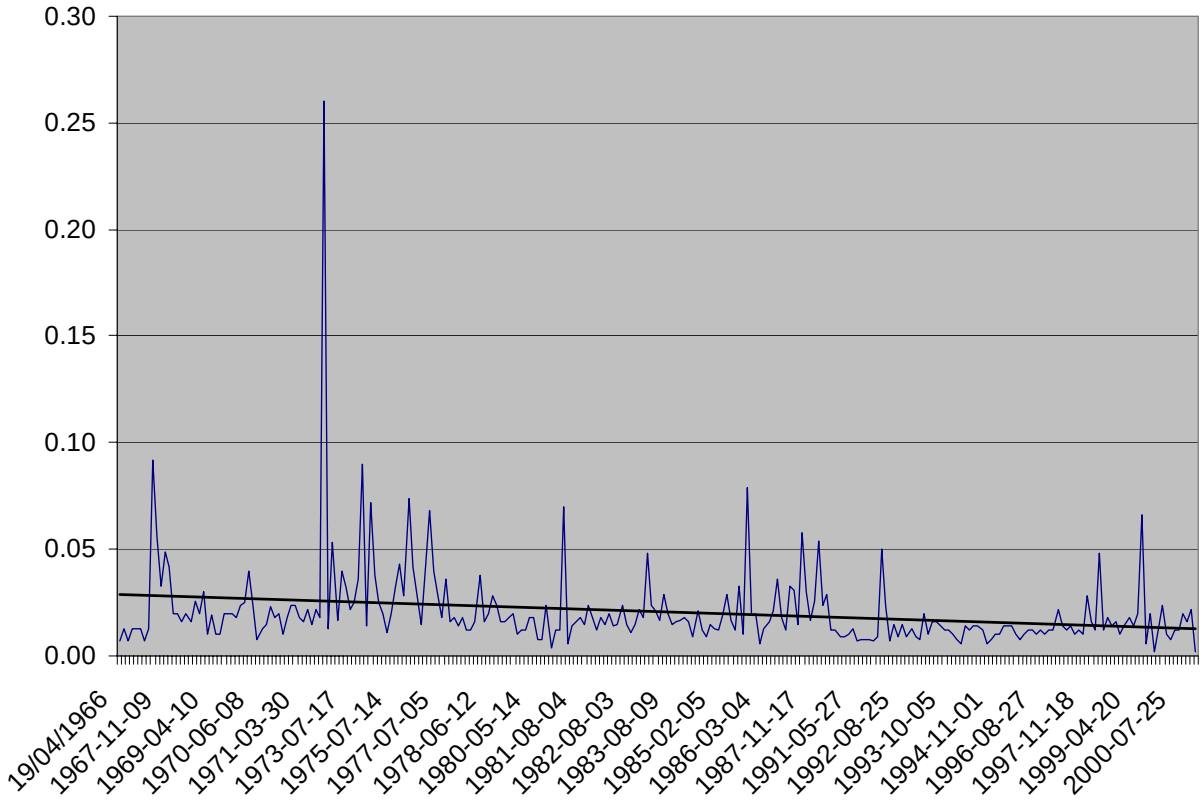

Figure 32. Total phosphorous levels at Chats Falls (1966-2001).

anglers about low walleye abundance in Lac des Chats. This is consistent with the low number of walleye caught in the 1990 survey.

There is a commercial fishery for lake sturgeon on the Québec portion of Lac des Chats with quotas established at 0.1 kg/ha (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). In addition, there is one licensee on the Quebec portion for bullhead, crappies, suckers, and eels.

Wildlife

At least 19 water birds and 10 raptors (including the peregrine falcon) have been previously reported to breed in this reach of the river (Table 5) (Cadman et al. 1987).

An Envirocon Ltd/Proctor & Redfern Ltd. (1979) study found five waterfowl and shorebird species, one amphibian species and one reptile species in this area. Osprey have been reported to nest on Morris Island just west of Fitzroy Harbour.

Waterfowl use the mouth of the Mississippi River (Sankey 1987). At Morris Island, cormorants are found near the railway bridge where water remains open all year. Gulls, terns, jaegers, accipiters, and falcons can be found in spring, and gulls and puddle ducks in fall, at the mouth of the Madawaska River in Arnprior. Diving and puddle ducks, cormorants, great egret, and tundra swan have been found at the mouth of Bonnechere River. Common terns nest on islands in river. Marshes to the north have least bitterns (Sankey 1987). Aquatic birds have been reported to concentrate in the area of Bristol/Braeside and Île Elliot and Chenaux Island (SFEP 2001).

A 1993 aerial survey by Ontario Hydro staff indicated that there were two muskrat colonies in Baie Feline and a colony in Quebec across from Arnprior.

Twenty-two amphibians and reptiles have been reported in this reach (Table 6) (Oldham and Weller 2000).

Unique species

There are a few unique or less common species in this reach of the river. Two vulnerable species (red-shouldered hawk and river redhorse) have been reported in this reach of the river (Table 7) (OMNR 2001). A grasshopper sparrow has been reported in Baie à John. Some of the highest concentrations of common map turtles have been found in this reach (Daigle et al. 1994).

Wetlands, parks, and environmentally sensitive areas

There are four provincially significant wetlands in this section of river: the Mississippi Snye Wetland; Morris Island Wetland on the west/central shore of Morris Island; Nopoming Wetland; and the Bonnechere River Marsh (Table 8) (OMNR 2001a). A large wetland, located across the river from Braeside is an ecological reserve, Projet du Refuge Faunique de Bristol (SFEP 2001).

Life science ANSIs are found on Victoria Island and the Mississippi Syne (Table 9) (OMNR 2001a). The Victoria Island ANSI centres on the remains of a timber slide constructed on the island in 1835 (Fourier 1979).

There are public beaches/parks in Arnprior on both the east and west shores of the Madawaska River mouth.

Shoreline development

Most of the Ontario shoreline is privately owned and occupied by over 450 cottages and homes in this section of the river (based on review of topographic and Ontario base maps). Year round cottage habitation is increasing. Since 1961, Arnprior, another major user of the river, has experienced an increase, i.e. 30%, in population (Ontario Water Resources Commission and Québec Water Board 1972; Statistics Canada 2001) (Table 10). There is a federal dock/boat launch at Arnprior. There are ongoing proposals for large-scale works, including marinas, beaches, utilities and waste treatment plants. The town of Braeside, with its Tembec Mill, is a major water user. It also has a public beach.

There is a proposed boat bypass at the northern-most sluice/dam at Chats Falls on the Québec side with another proposed bypass through Fitzroy Harbour and Laverge Point. There is a canoe portage route around the Chats Falls GS. Access is via the south side of the Victoria Island sluiceway.

This reach is second to the Lac Dollard des Ormeaux reach in agricultural land use in the watershed with up to 27% of the Mississippi River sub-basin in agriculture (Table 11) (Telmer 1996). However, there is little in the way of built-up area in this reach.

Lac du Rocher Fendu (Cheneaux to La Passe Dam)

Pre-development description

Chenaux

The Chenaux Rapids were a strong set of rapids, however, were considered insignificant in power by Thomas Keefer, a prominent civil engineer in the early 1800s (Kennedy 1970). The rapids were described as a smooth, strong current, which can hardly be termed an interruption in navigation (Sherriff 1831).

Alterations to the river began with the construction of a log slide in 1839 at Portage du Fort. This log slide was ruined by flood waters during the spring of 1840, and was rebuilt in 1841 (Legget 1975).

Originally, the river upstream of Portage du Fort flowed amongst many small islands and contained areas of shallow, fast flowing water (Figure 33). The river had two main channels that flowed around Limerick Island (Figure 34). The greater flow of the river was on the Ontario (western) side of this island (Figure 35; Denis and White 1911).

Bryson

Calumet Falls and accompanying rapids extended over 1.6 km and dropped 18.2 m (Kennedy 1970) through a rocky gorge interspaced with a number

Figure 33. Rapids upstream of Portage du Fort bridge prior to the construction of Chenaux Generating Station (OHSC Archives Neg. No. 1951).

of small islands (Pawson 1927). The Chenal du Grand Calumet was easier to navigate than the Chenal du Rocher Fendu due to the number of rapids in the latter section. Therefore, log drives were often through this section. The first log slide was constructed at Calumet Falls in 1843 (Tremblay et al. 1970; Legget 1975).

Existing physical description
Chenaux

Construction of the Chenaux GS (GS) began in 1948 (Biggar 1991) and was centered around Limerick Island. A discharge channel 94.5 m wide and 457.2 m long was excavated through the island to carry flood waters controlled by Limerick Island Dam (Figure 36; Hydro-Electric Power Commission of Ontario 1950a). This dam is 335 m long and 18 m at maximum height (Figure 37; Biggar 1991). Two other dams were constructed, including the generating station (Figure 38) and Portage du Fort Dam (Figure 39). The length of the generating station is 427 m, with a maximum height of 18 m and the Portage du Fort Dam is 427 m, with a maximum height of 21 m (Biggar 1991). Additional characteristics of the Chenaux Dam are outlined in Table 2. The dam was completed and operational by December 1951 (Biggar 1991).

As a result of the construction of Chenaux Dam, approximately 809 hectares (ha) of land was flooded (Biggar 1991). The water level at the site of the dam was raised approximately 12.7 m. Flooding occurred to the base of Bryson Dam (Figure 9), drowning several sets of rapids in this section of river. The water level at the Rocher Fendu Chute was raised 8.6 m; at Labarriere Rapids 2.1m; and at Mountain Chute 1.8 m. The water level in the widest part of the river was raised approximately 8.7 m. Water levels are currently affected up to the Muskrat Rapids in Chenal du Rocher Fendu.

Lac du Rocher Fendu is a 31.1 km section upstream of the Chenaux GS to the small village of LaPasse. The impoundment forms a lake approximately 1,862 ha, 11 km long and averaging 1.6 km wide (Biggar 1991). Most of the impoundment varies from 10–20 m deep and reaches a maximum of 60 m. The river divides into two channels around Île du Grand Calumet. Chenal du Rocher Fendu flows along the east side of the island and is considered the “white water” rapid section. Numer-

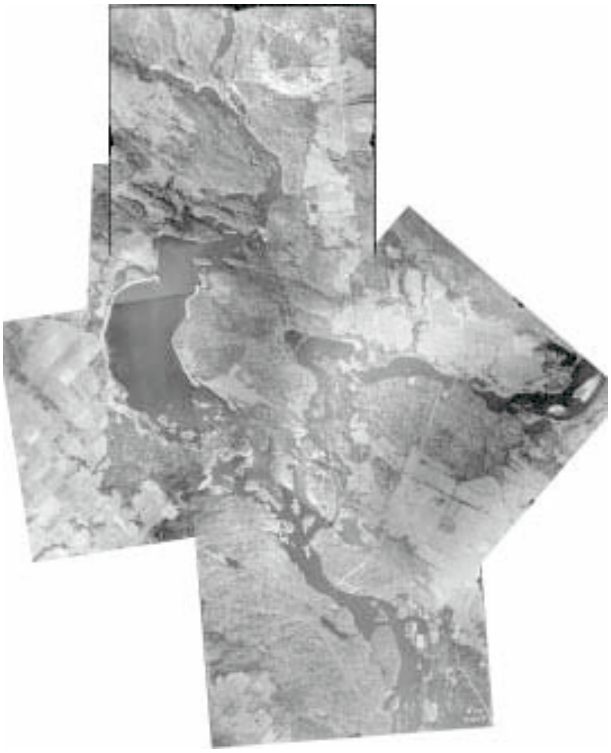

Figure 34. Aerial mosaic of Lac du Rocher Fendu prior to the construction of the Chenaux Generating Station.

Figure 36. The overflow channel constructed through Limerick Island (2000).

Figure 35. Historical view of the rapids where Chenaux Generating Station was constructed. View is from the east on Limerick Island (OHSC Archive Neg. No. 1947).

Figure 37. Limerick Island control structure (2000).

Figure 38. Cheneaux Generating Station (2000).

Figure 39. The dam constructed at Portage du Fort (2000).

ous rapids remain in this section of the river, dispersed among many small islands, and are currently used as a source of recreation for rafters and kayakers. Hargreaves (1998) offers detailed descriptions and aerial views for each rapid in this section for recreational purposes. Chenal du Grand Calumet flows along the west side of the island. The surface area of the whole section is 3,893 ha.

The drainage area for Chenaux is 74,527 km^2 (OMNR 1985).

Bryson

Construction of the existing structure at Bryson began in October 1923. The dam was constructed immediately above the foot of the rapids. The dam is 115.8 m long, 21.3 m high, contains 12 sluice gates and a log slide. The generating station was not included as an integral portion of the main dam, but was situated downstream and connected by a canal excavated along the western bank. The canal was 27.4 m wide, 137.2 m long and 12.3 m deep. The generating station is 72.5 m long by 38.1 m in width (Pawson 1927). Bryson GS was put into service in 1925 (Figure 40) near the end of the 35 km Chenal du Grand-Calumet (Kennedy 1970). Some additional features of Bryson Dam are outlined in Table 2.

Prior to the construction of the Bryson Dam, normal upstream water levels were 105.9 m, and

Figure 40. Bryson Dam (1997).

maximum flood were 107.2 m. The maximum elevation of the pond level after the completion of the dam was 107.2 m (Pawson 1927).

A dam was built in the Chenal du Rocher Fendu between Sullivan Island and Calumet Island to raise the water for a canal on Culbute channel on the north side of Allumette Island. It was originally completed in 1876 (Kennedy 1970). The existing structure now serves to ensure there is sufficient flow to the Bryson GS (Hargreaves 1998).

The drainage area for Bryson Dam is 74,281 km^2 (OMNR 1985).

Both shorelines are very irregular (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). Points and bays are numerous. The white water area flows mainly through bedrock. Shorelines rise abruptly and islands are numerous. Lac du Rocher Fendu has a more gentle contour. Shoreline substrates include sand, silt, clay, gravel, and rock outcrops. There are clay banks up to 10 m high on the upper end of the impoundment.

Present hydrology

Most of Lac du Rocher Fendu varies from 10–20 m in depth (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). The upper third of this impoundment is deeper and reaches a maximum depth of 60 m.

The Chenaux GS is used as a peaking station and is subjected to extreme water fluctuations within a 24 hr period. However, the mean monthly variation is not that great (Figure 41). The average annual drawdown is 1.6 m, where the maximum drawdown is 1.9 m (Efford 1975). Station flows are regulated hourly (daily cycling) to match power demand. The average daily discharge must be equal or greater than the Lake Temiscaming average discharge of two days prior plus 40 m^3/s. A flow change due to Des Joachims will be seen at Chenaux two and a half days later.

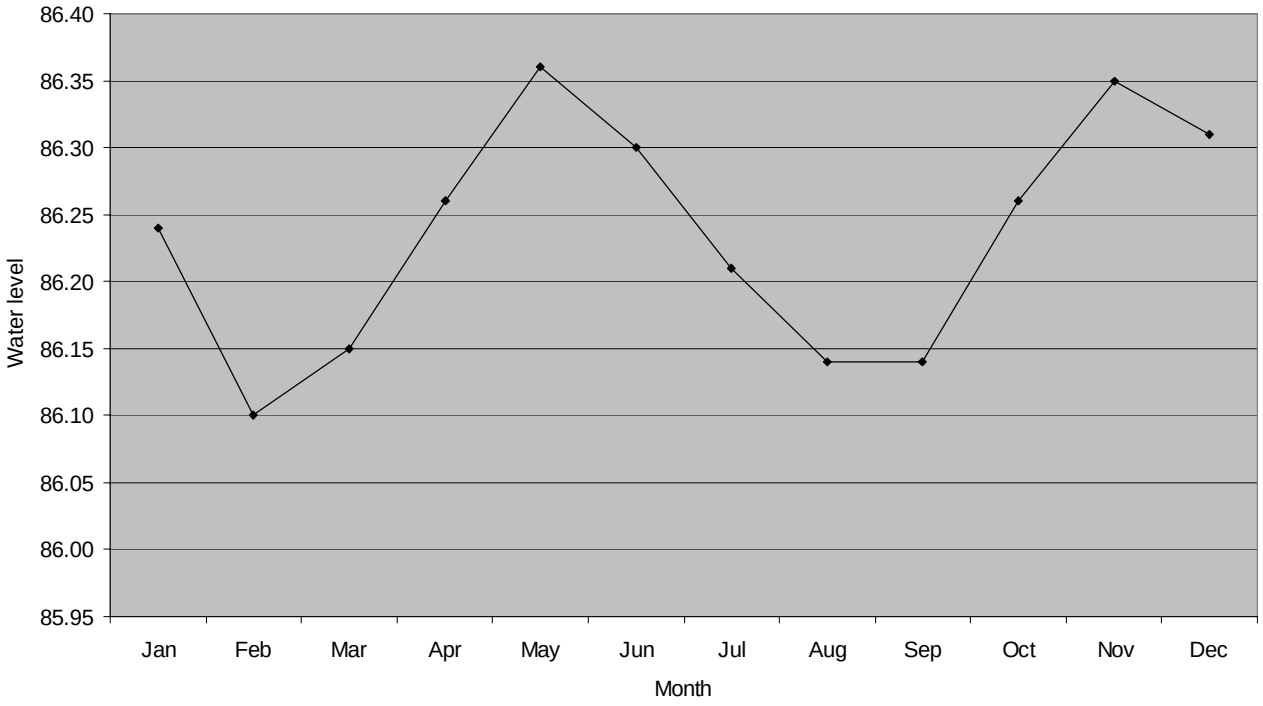

Figure 41. Mean monthly water levels in Lac du Rocher Fendu over the past 50 years.

Spillage to the Portage du Fort Dam and the Limerack Island Dam generally occurs during peak flows from mid-April throughout May when river flows exceed 1250 m^3/s.

Chemical characteristics

Higher than normal concentrations of metals such as copper, zinc, nickel, and lead have historically been noted in this reach (Environment Canada et al. 1985). In the past, BOD levels sampled at Chenaux GS have tended to range between 0.25 and 3.0 mg/l (Figure 42) and total phosphorus between 0.01 and 0.04 mg/l (Figure 43). Total Kjeldahl nitrogen levels measured between 1978 and 1985 at Chenaux have averaged around 0.25 mg/l with highs of 0.4 mg/l (Telmer 1996).

Natural environment

Fisheries

This reach of the river supports a diverse coolwater/warmwater fisheries with at least 25 species documented (Appendix 1). Walleye, smallmouth bass, northern pike, and sauger are some of the common sport species (Table 4). Channel catfish are the most abundant species in this section of river based on recent assessment netting (Haxton 1998 and OMNR 2000). Other species present include brown bullhead, redhorse species, and lake sturgeon (Table 4). American eels have not been sampled in this reach in recent years. A freshwater drum was sampled in 2000 (Appendix 1).

Walleye are known to spawn in the remaining natural rapids, at the outflow of Canal du Grand Calumet and below Bryson Dam. A recent radiotelemetry study on the movement of walleye in Lac du Rocher Fendu revealed that the rapids in the upper section of this reach are not a natural barrier to this species' upstream migration (Kirby Punt, pers com). Lake sturgeon historically spawned near the islands upstream of Portage du Fort, but these areas were flooded after the construction of the Chenaux Dam.

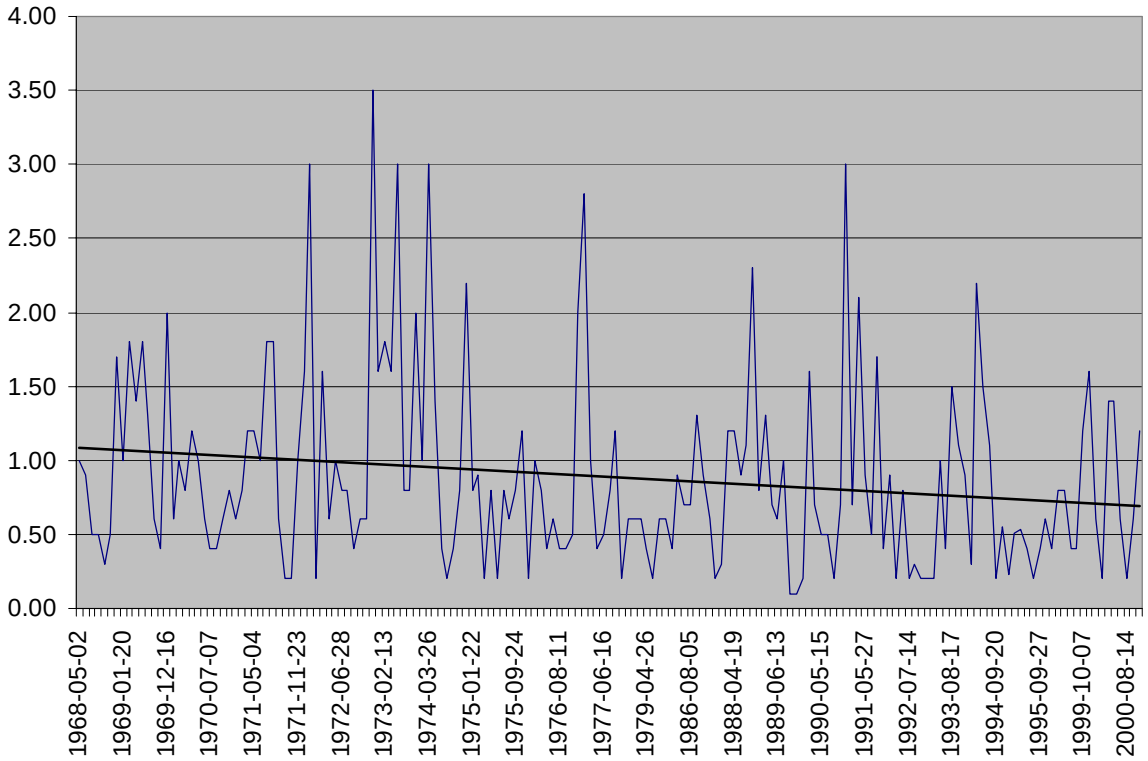

Figure 42. Biological Oxygen Demand levels at Chenaux, 1968 - 2000.

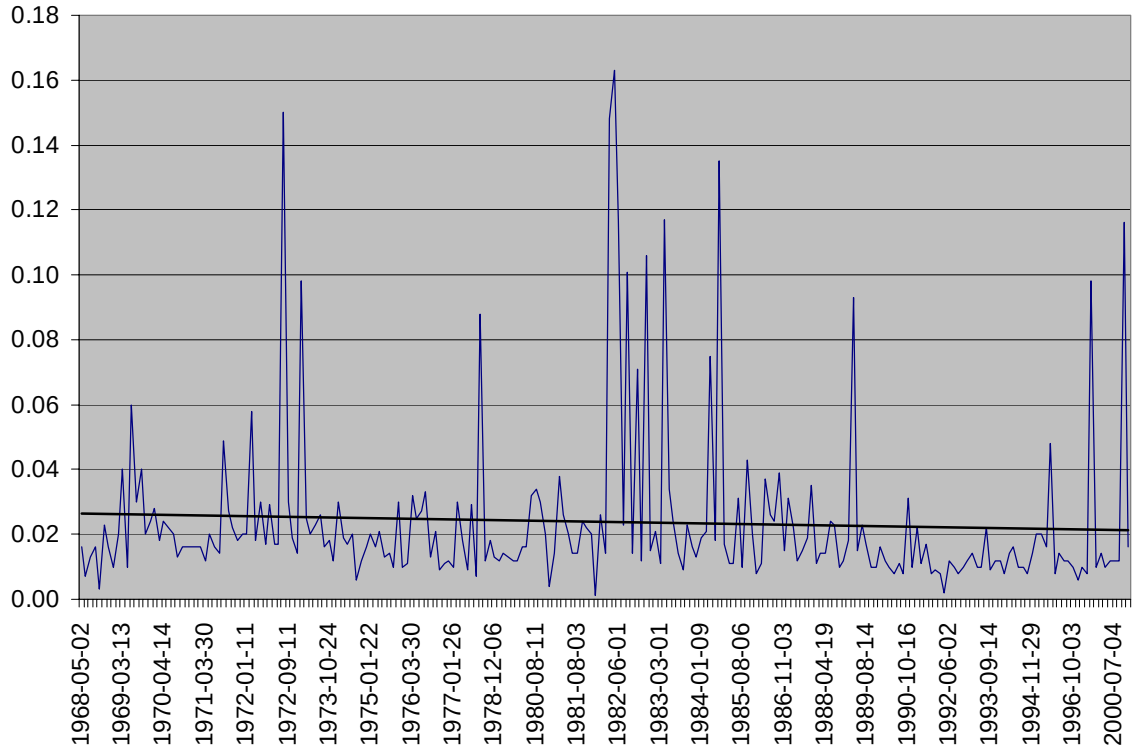

Figure 43. Total phosphorous levels at Chenaux, 1968 - 2000.

There is a commercial fishery for lake sturgeon in this reach licensed out of Québec with a quota of 0.1 kg/ha (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999).

Wildlife

At least 14 water birds and four raptors (including the Cooper's hawk) have been reported to breed in this reach of the river (Table 5) (Cadman et al. 1987). Waterfowl concentrations have been reported downstream of Bryson and in Lac du Rocher Fendu during migrations.

A 1993 aerial survey by Ontario Hydro staff indicated that there were several muskrat colonies located along the Chenal du Grand Calumet downstream of La Passe.

Fifteen species of amphibians and reptiles have been reported in this reach (Table 6) (Oldham and Weller 2000).

Unique species

There are a few unique or less common species in this reach of the river. There are reports of water snakes near Sullivan Island (Table 7). The ram's head lady slipper has been reported near Bryson. Some of the highest concentrations of common map turtles have been found in this reach (Daigle et al.1994).

Wetlands, parks, and environmentally sensitive areas

In this reach of the river there are wetlands located at Hazelton and Lorne Islands and Killoray Bay.

A 125 ha section of the Ottawa River downstream of La Passe has been designated a Provincial Waterway Park due to its untouched shoreline and white water characteristics (Table 9).

Shoreline development

Three commercial white water rafting outfitters run expeditions on this section of river with two, Owl Rafting and Wilderness Tours, having lodgings and

associated recreational facilities based at Byces Point. Consolidated Bathurst established a paper mill at Portage du Fort in 1966. Bryson has a pulp and paper mill as well.

There are municipal drinking water systems downstream of La Passe, including Bryson and Campbell's Bay.

Since 1961, some communities have experienced a decline in population, e.g. Campbell's Bay, while others have increased in size, Ontario Water Resources Commission and Quebec Water Board 1972; Statistics Canada 2001) (Table 10).

Allumette Lake and Lac Coulonge (LaPasse to Des Joachims)

Pre-development description

This reach of river extends approximately 90 km and consists of several "lakes" separated by short rapids (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999) (Figure 1). Aside from development along the shoreline, this reach of river remains much the same as it was prior to hydroelectric development (Legget 1975). The shoreline remains relatively unaltered due to the construction of hydraulic structures (Ottawa River Engineering Board 1965).

Existing physical description

The "lakes" (reaches) include Lac Coulonge, Lower Allumette Lake and Upper Allumette Lake. Lac Coulonge is 18.1 km in length, with a surface area of 2,888 ha. The Rapides Paquette and a concentration of islands separate Lac Coulonge and Lower Allumette Lake. The Ottawa River flows around both sides of Île des Allumettes. Chenal de la Culbute is the smaller channel with several sets of rapids, Rapides de la Culbute, Rapides de l'Islet and Rapides du Chapeau, that flows 21.8 km along the north side of the island. Lake-like conditions exist along the southern side of Île des Allumettes. Lower Allumette is approximately 22.3 km long, with a surface area of 4,613 ha.

Lower Allumette and Upper Allumette are separated by three sets of rapids, Rapides des Allumette, Lost Channel and Beckett Island Rapids, located amongst islands immediately downstream of the interprovincial bridge. The Upper Allumette Section is 76.9 km long with a surface area of 18,212 ha. The river is relatively calm upstream of the inter-provincial bridge except near Petawawa where there are numerous islands. Depths average 10–15 m in Allumette Lake. The Petawawa area is particularly shallow. From the Deep River Inlet / Pointe Malin to Rolphton / Rapides des Joachims, the river is deep reaching a maximum of over 60 m. Surveys in 1991 determined that this section thermally stratifies (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999).

The main tributaries in this section of river include Rivière Coulonge, Rivière Noire, Muskrat River, Petawawa River and Schyan River. The mean annual discharge of selected tributaries is described in Table 3.

Both shorelines are scalloped and punctuated by points (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). The lower part of the reach has a low gradient with variable shoreline substrates including silt, sand, clay, gravel and occasional rock outcrops. Sand predominates in the Petawawa area. Steep granite cliffs dominate the Québec shoreline from Pointe Malin to Rapides des Joachims.

Present hydrology

The water levels in this section are quasi-natural. The level is affected by the flow of water which is regulated upstream by the Des Joachims Generating Station. Water levels in Allumette Lake fluctuate on average 0.72 m, from a high of 111.91 m in May to a low of 111.19 m in September (Figure 44).

Chemical characteristics

OMNR surveyed the water chemistry of Lower Allumette Lake, near Westmeath, in 1970 (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). This reach was not thermally stratified due to the high flushing rate that prevents stratification. pH at survey stations

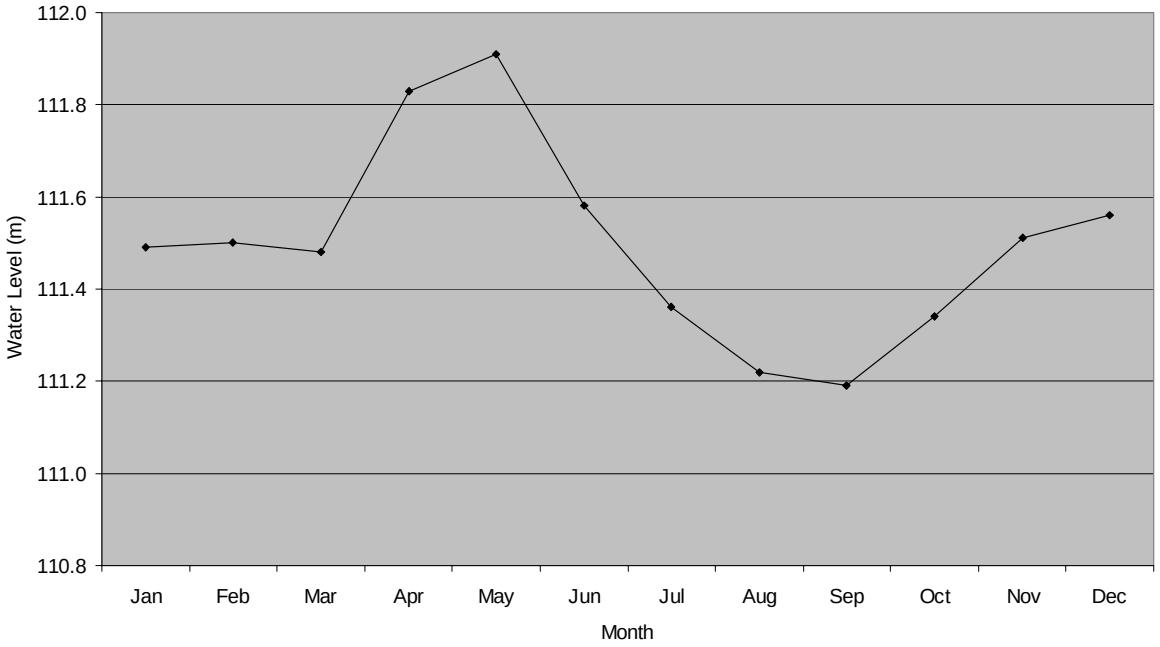

Figure 44. Mean monthly water levels in Allumette Lake over the past 50 years.

was neutral. Conductivity was measured at 65 µhos/cm in the fall of 1997.

Natural environment

Fisheries

This reach supports diverse warmwater and coolwater fish communities with at least 55 species documented (Appendix 1). Walleye is the main species sought by anglers. Catches typically include walleye, pike, channel catfish, smallmouth bass, and lake sturgeon. Walleye anglers concentrate their effort near the Highway 148 bridge, Île Leblanc ("lighthouse"), Petawawa and Schyan river mouths, and Rolphton/Rapides Des Joachims. There is a small trophy muskie fishery near Petawawa. Several walleye, bass, and multi-species tournaments and derbies occur during the year. Catches during the bass derby are typically half of those in southern Ontario derbies.

American eels were one time considered abundant in this section of river, such that this species dominated the bones found in archaeological digs on Morrison Island (Pilon 1999). Eels have not been sampled in this reach in recent assessment efforts. Channel catfish are the most abundant species in these reaches (Haxton 2000a, 2000b; OMNR 2001b). Lake sturgeon numbers are the greatest in this reach when compared to the other reaches of the Ottawa River (Haxton in review).

An early season access creel in 1993 on the Ontario side of Allumette Lake estimated an effort of 25,120 angler hours in the first six weeks of the season, harvesting an estimated 6,348 walleye (Haxton 1997).

Lake trout were introduced in the Deep River area in 1993 and stocked for three years to use cold water habitat located there. However, a netting assessment in 1996 targeted at lake trout failed to sample any returns and very few reports of lake trout being caught have been received.

Walleye spawn in areas of natural rapids throughout the reach, in tributaries of the river, amongst the islands off Petawawa Point and below Des Joachims Dam. Muskellunge have been observed at the delta of the Petawawa River. Lake sturgeon are known to spawn in the Allumette Rapids and a small tributary near McConnell Lake. Suckers spawn in most tributaries and natural rapids.

There is a commercial fishery for lake sturgeon licensed out of Quebec with a quota of 0.1 kg/ha of

Québec water. There is also a commercial fishery for bullhead, crappie, suckers, and eels based out of Québec.

Wildlife

At least 34 species of water birds and 11 raptors (including the peregrine falcon, Cooper's hawk, and merlin) have been previously reported to breed in this reach of the river (Table 5) (Cadman et al. 1987). Peregrine falcons are known to nest on the cliffs across from Chalk River.

Heron colonies are reported near Rapides de la Culbute, Deep River, and Rapides-des-Joachims (Sankey 1987). Herring and ring-billed gulls nest on islands in Allumette Lake between Pembroke and Petawawa.

Waterfowl concentrations have been reported at Lac Nanny, Bellows Bay, Lac Downey, and Pointe Seche. Westmeath Provincial Park (Bellow's Bay) has had a diversity of waterfowl, peregrines falcons, and ospreys (Sankey 1987). It has served as a spring staging area for numerous diving and dabbling ducks including the ring-necked duck, bufflehead, and hooded merganser (Michener 1996). Nearby O'Brien Bay is open all winter and has been used by common goldeneye (Sankey 1987). Rapids north of Morrison Island have waterfowl in the fall e.g. commin goldeneye (Sankey 1987). Its open waters during the winter have attracted common merganser, common goldeneye, Barrow's goldeneye, and harlequin duck (Michener 1996). Bald eagle, common merganser, common goldeneye, and gulls have been sighted in the open water around Rapides-des-Joachims during the winter (Michener 1996). Also, bald eagles have been sighted at Deep River and Petawawa, and gyrfalcons at Deep River (Michener 1996).

Goodwin (1995) noted that the largest recorded swallow roost in Ontario was sited at the confluence of the Muskrat and Ottawa Rivers at Pembroke in 1983. Although it no longer exists, all six species of swallows, and merlins, had been found at this roost.

A 1993 aerial survey by Ontario Hydro staff indicated that there were several muskrat colonies in the vicinity of La Passe.

Twenty-six species of amphibians and reptiles have been reported in this reach (Table 6) (Oldham and Weller 2000; Coulson pers comm[6]).

Unique species

There are a number of unique or less common species in this reach of the river. Cryptandus dropseed, Smith's club-rush and Torrey's bulrush have been found in the area of Fort Coulonge (Table 7). Bald rush has been reported to occur near Île Leblanc and Douglas buckwheat at Roche à l'Oiseau.

Wood turtles have been found in Welch Bay near Deep River and Fort Coulonge, map turtles near Îles Finlay, and spiny softshell turtles (a threatened species) near Îles Finlay and Fort William. Peregrine falcons have been observed at Pointe à l'Oiseau downstream of Deep River.

Other less common species such as the sandhill crane, western sandpiper, stilt sandpiper, least bittern, tundra swan, ruddy duck, pomarine jaeger, parasitic jaeger, laughing gull, sabine's gull, Caspian tern, northern hawk owl, great gray owl, and long-eared owl have been sighted at Deep River, and long-tailed duck, buff-breasted sandpiper, short-eared owl, and boreal owl in Pembroke (Michener 1996).

Wetlands, parks, and environmentally sensitive areas

The Ontario side of this reach contains two provincially significant wetlands: Bellow's Bay, HazleyBay/Lisk Bay Complex (Table 8) (OMNR 2001a). Wetlands in this reach which may be provincially significant include Hales Creek, Hennessy's Bay, Malloy Bay, and Lacroix Bay. Other wetlands include Baie Downey, Fort

[6] Daryl Coulson, District Ecologist, Pembroke District.

William, Black Bay, Baie des Roy, Îles Finlay, Pte Seche, and La Passe.

There are three environmentally sensitive areas in this reach of the river in Quebec, i.e. the Ruisseau de l'Indien RPF opposite Deep River, James Little RPF and De l'Aigle à Tête Blanche RPF at the junction of the Des Joachims GS tailrace and spillway (Table 9) (SFEP 2001). ANSIs are located near Petawawa (life science ANSI) and La Passe (Pipeholes earth science ANSI) (Table 9) (OMNR 2001a).

There are town parks and roadside parks located at Rapides des Joachims, Deep River, Petawawa, Pembroke, and Cotnam Island.

Shoreline development

The cities of Pembroke and Petawawa are two of the major developments along the shoreline of this reach of river. Other towns along the river include Fort Coulonge, Waltham Station, Chapeau and Deep River. Atomic Energy Canada Limited (AECL) has a major research facility constructed along the shoreline of the river at Chalk River. A Canadian forces base occupies the land between AECL and Petawawa. Since 1961, some communities have experienced a decline in population, e.g. Fort Coulonge, Deep River, and Pembroke, while others have increased in size, e.g. Petawawa (Ontario Water Resources Commission and Quebec Water Board 1972; Statistics Canada 2001) (Table 10).

In conjunction with the recently completed marine bypass system around Des Joachims GS, the Corporation Passe des Rapides (1993) has proposed a tourist development plan for the adjacent island of Rapides des Joachims.

Shoreline development is quite heavy on the Quebec shoreline of Upper Allumette Lake between Petawawa and Pembroke and equally so between Petawawa and Moore's Beach downstream of Pembroke on the Ontario shoreline. Wide sandy beaches have resulted in numerous recreational buildings and heavy boating activities.

There are a large number of municipal drinking water systems downstream of Des Joachims GS including: Fort Coulonge, Deep River, Petawawa's Canadian Forces Base, and Pembroke.

Industrial water intakes downstream include Petawawa Golf Club, County of Renfrew Roads Department, Commonwealth Paper Mill, Chalk River Nuclear Laboratories, and the Nuclear Power Demonstrator at Chalk River.

Over 1000 homes and cottages have been identified downstream (based on a review of topographic maps and Ontario base maps) in locations outside areas served by a piped water supply.

This reach of river has a long history of settlement with native people settling Morrison and Allumette Islands over 5000 years ago (Kennedy 1970). Lac Coulonge was initially the location of several trading posts (Kennedy 1970). Fort Coulonge was founded on its north shoreline in the 1680s and a Hudson's Bay Company trading post on its south shoreline in 1836. The Hudson's Bay Company also built a post at Fort William on Allumette Lake in 1846.

In comparison to the whole Ottawa River watershed, agricultural land use in the watershed of this reach is low, e.g. 0.2 to 1.5% of the tributary subbasins (Table 11) (Telmer 1996).

Holden Lake (Des Joachims to Otto Holden Dam)

Pre-development description

Historically, there were two stretches of rapids at Rapides des Joachims within a distance of 2.4 km with a drop of 7.1 m (Kennedy 1970). These rapids were described as a heavy continued run of water for upwards of 1.5 km, forming a circular sweep to the southwest (Figures 45 and 46; Sherriff 1831). The river divided amongst several small islands to form the upstream rapids (Figures 47 and 48). Upstream of these rapids was an ancient river channel (Figure 45). Historically, the Ottawa River flowed through McConnell Lake, however, this channel eventually became blocked by an accumulation of sand, gravel and boulders (Ells 1901).

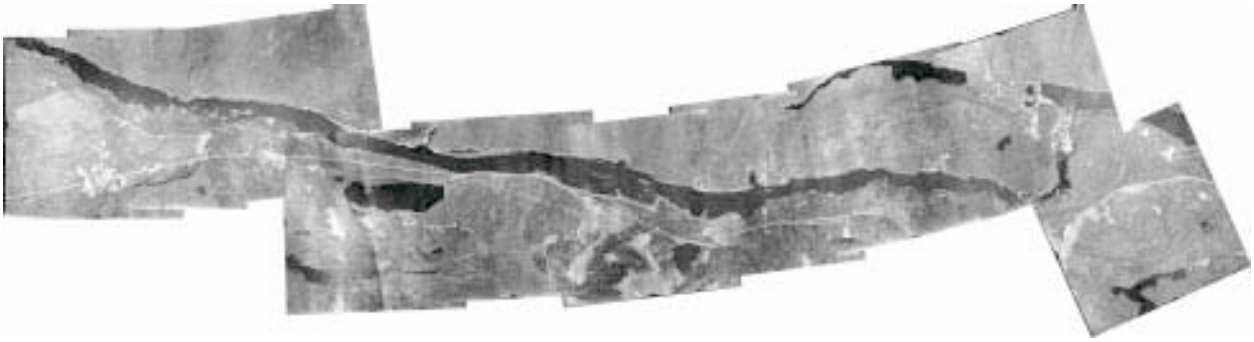

Figure 45. Aerial mosaic of the Ottawa River upstream of Des Joachims to Bissett Creek pre-hydroelectric development (1946).

Figure 46. Aerial view of rapids des Joachims from downstream, 1925 (National Archives of Canada PA 44399).

Log slides were constructed at the Rapides des Joachims by the Government of the Union in 1844 to assist log drives (Tremblay et al. 1970).

Rapides-des-Rocher Captaine were considered one of the most intriguing set of rapids and portages. Located 32.1 km upstream of Des Joachims, at Rocher Captaine Island (Figure 45; Kennedy 1970), these rapids formed an interruption for 2.4 km (Sherriff 1831) and were described as fierce, violent and crooked (Kennedy 1970). The rapids were very dangerous, having intricate channels, eddying whirlpools, boulder deposits, and rocky projections (Tremblay et al. 1970). They were approximately 183 m wide along the northern side of Rocher Captaine, for a distance of a 2.0 km. The river made a fairly sharp turn southwards into "a great cauldron-shaped" space about 0.4 km across, then swung northwards and tumbled down more rapids in another equally narrow channel for 150 m. The total fall of these rapids was 13.1 m (Kennedy 1970). The area was described as one of the finest scenes of rapid water on the Ottawa (Sherriff 1831). A description of this area by Sherriff (1831) follows:

> "*The whole of its water are, for some distance, condensed into a channel four or five hundred feet in breadth, the foot of which is crossed by a range of rocks, extending from the north shore and terminated by one superior size, about an acre in extent. Against these, the river is precipitated with a force which completely curves the surface of its channel several feet from the horizontal, and thus forced abruptly to the right, it descends in great heaving swells, through a pass two or three hundred feet wide, curling up into fierce breaks, when fairly clear of the strait.*"

Limited history exists on alterations for this set of rapids. Lumbermen built a wagon road to bypass the rapids (Kennedy 1970). Rock excavation was undertaken at site by the government and a crib slide, approximately 8.4 m wide, 61.0 m long, was constructed in 1874 (Tremblay et al. 1970).

The Rapides-des-Deux-Rivières were located 16 km upstream of Rocher Captaine. There were three

Figure 47. Historical view of the upstream rapids at Rapids des Joachims, 1947 (Hydro One Archives Neg. No. 72).

Figure 48. Historical view of the downstream rapids at Rapids des Joachims, 1947 (Hydro One Archives, Neg. No. 1284)

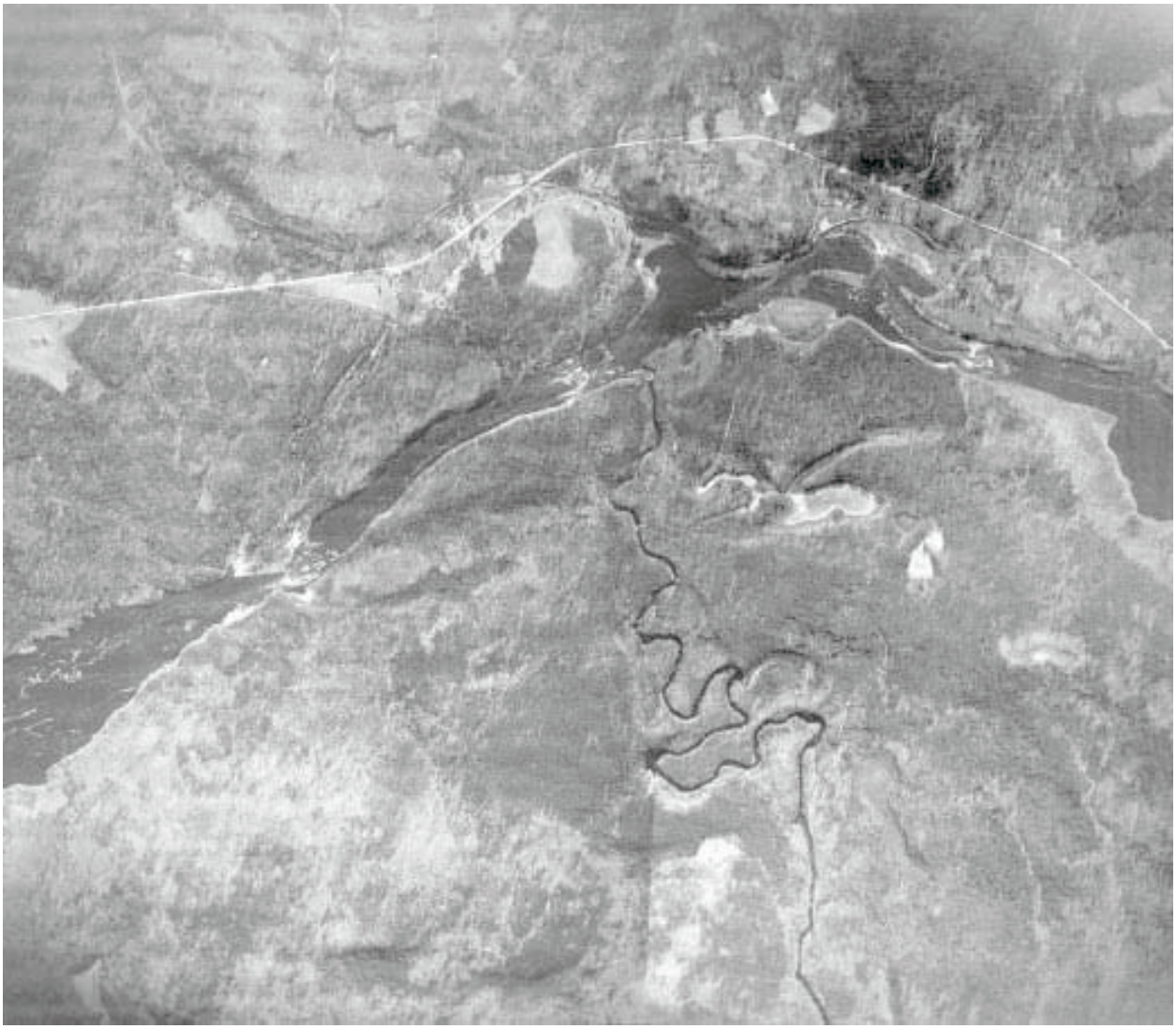

Figure 49. Aerial view of the Rapides-des-Deux-Rivières, 1946.

sets of rapids all within 4.0 km (Figure 49). The first set of rapids, Deux-Rivières rapids (Figure 50), was a vast accumulation of boulders that fell 4.0 m. The middle set of rapids Trou Rapids, located at the mouth of Magnasipi River, fell 2.7 m. The top set of rapids, the Veillée Rapids, fell 2.4 m (Kennedy 1970).

Existing physical description

Construction of the Des Joachims Dam began in the fall of 1946 with the clearing of 4,452 ha of land between Des Joachims and Mattawa (Biggar 1991). An auxilary dam, the McConnell Lake Control Dam, was constructed at the upper end of the ancient river channel to provide a convenient means of by-passing excess flow (Figure 51). McConnell Lake Dam is 95 m long with a maximum height of 37 m (Biggar 1991). Water was passed through the McConnell Lake control dam for the first time in August 1949 (Hydro-Electric Power Commission of Ontario 1950b) since the ancient river became blocked during glacial retreat (Ells 1901).

The generating station was constructed in the main channel of the Ottawa River, at the top of the

Figure 50. Historical view from the foot of Deux Rivières rapids pre-hydroelectric development (National Archives of Canada C 22122).

Figure 51. McConnell Lake Dam (2000).

Figure 52. Des Joachims Dam and tailrace channel (1997).

Rapides des Joachims (Figure 52). The main dam is 730 m long and has a maximum height of 37 m. The auxiliary dam is located north of the main dam and is 335 m long with a maximum height of 15 m (Biggar 1991). Additional features of the Des Joachims Dam are outlined in Table 2. In order to permit unobstructed flow from the generating station, a tailrace channel approximately 2.1 km long and 53.3 m wide was excavated through solid rock in the Des Joachims Rapids section of the river (Hydro-Electric Power Commission of Ontario 1950b). A swift current remains (Figure 53) where the lower rapids once raged (Figure 54).

The hydroelectric dam was completed by 1950. It altered or completely drowned the rapids at Des Joachims, Rocher Captaine and Deux-Rivières, raising water levels all the way to Mattawa (Kennedy 1970; Legget 1975). It flooded an area approximately 45.6 km^2 (Efford 1975). A lake-like environment was created 92 km in length (Biggar 1991), although a swift current is apparent at Klock due to the narrowing of the channel (Legget 1975).

This section of river currently has an average depth of 30 m with a maximum depth of 150 m off Marabou Point. The main tributaries include Dumoine River, Magnasipi River, and Mattawa River (Table 3).

Ontario's shoreline is gently rolling and composed of gravel, cobble and rock outcrops. The Laurentian Hills rise abruptly from the shoreline of

Figure 53. Swift current in the tailrace of Des Joachims Dam (2000).

Québec (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999).

Present hydrology

There is a winter drawdown of Holden Lake. Water levels generally start to decline in February and are at their lowest in April (Figure 55). The annual drawdown on average is 2.3 m, with a maximum drawdown of 3.0 m (Efford 1975). Fluctuations immediately downstream of Des Joachims Generating Station are generally a metre or less overnight.

Immediately downstream from Otto Holden Dam, daily water fluctuations may be as much as 1.5 m (Ontario Water Resources Commission and Quebec Water Board 1971)

The drainage area of Des Joachims is 57,500 km^2. The mean annual discharge at Des Joachims is 810 m^3/s (Telmer 1996).

Chemical characteristics

OMNR staff surveyed the water chemistry of Holden Lake in 1969 at Driftwood Bay, Moose Bay, Klock, and Bissett (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). There was no thermal stratification at these survey sites. The pH was 6.5, slightly acidic. Water quality in this reach has been historically influenced by the pulp and paper mill upstream at Temiscaming (Environment Canada et al. 1985). Low levels of dissolved oxygen and high levels of ammonia and nitrate have been reported.

Natural environment

Fisheries

This reach supports a coolwater/warmwater fishery with at least 36 species documented (Appendix 1). Walleye, sauger, northern pike, and smallmouth bass are the primary game fish present. Other species present include yellow perch, common white suckers, lake whitefish, and burbot (Table 3). Channel catfish are not abundant in this reach.

There was a commercial sturgeon fishery in this portion of the river near Mattawa until the mid-1970s. Lake sturgeon have declined in this reach and have not been sampled during recent netting efforts.

Figure 54. View of the lower rapids of Rapids des Joachims from the bridge, 1906 (National Archives of Canada C4914).

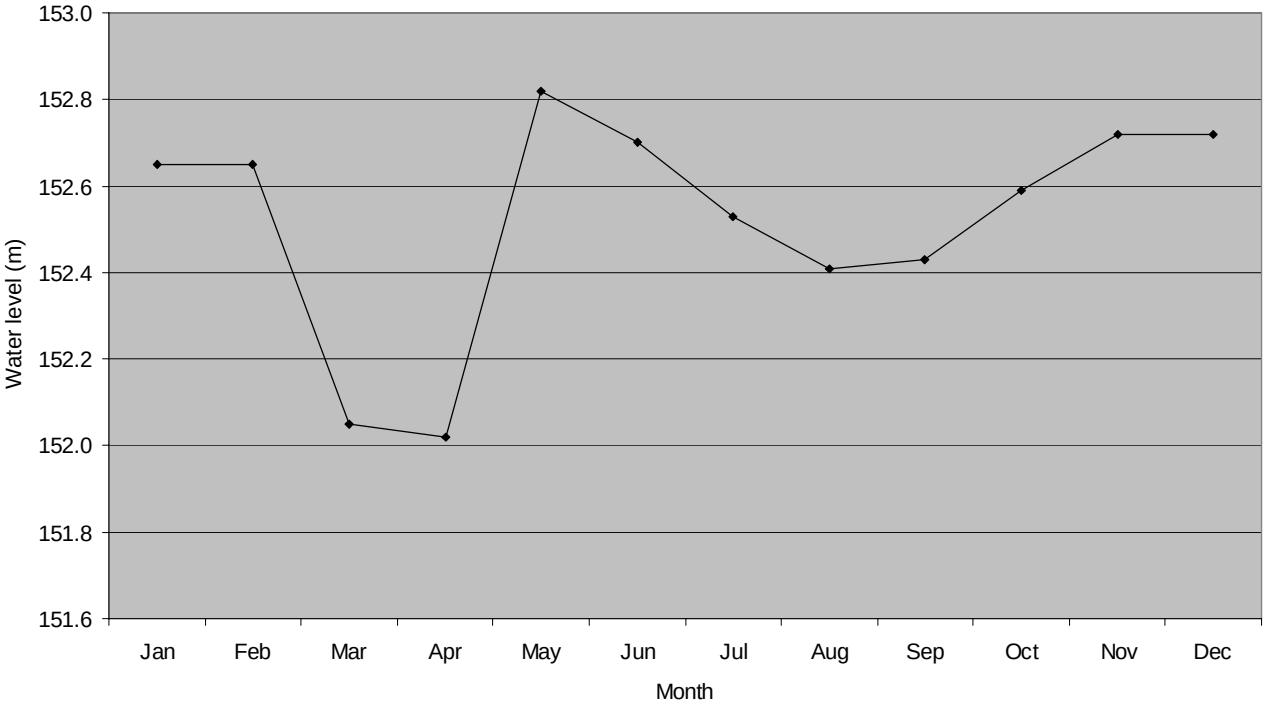

Figure 55. Mean monthly water levels in Holden Lake over the past 50 years.

Habitat for indigenous salmonids may exist in deeper sections. There are anecdotal reports of brook trout being angled.

There are no harvest data available for this reach but angling pressure is thought to be light overall with moderate fishing pressure on the river in the immediate vicinity of Mattawa (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). Anglers generally report good to excellent fishing for walleye and sauger. Anglers also report catching smallmouth bass, channel catfish, northern pike, and occasionally lake trout, brook trout, and burbot. On the rare occasion, they report catches of lake sturgeon and muskellunge. Downstream of the southern most generating unit at Otto Holden is a popular sport fishing location when the unit is not operational. Fish species caught at or near the generating station include walleye, pike, perch, smallmouth bass, lake sturgeon, and lake whitefish.

Other popular fishing spots downstream of the station for local residents include: the railway bridge at Mattawa; the Mattawa River just upstream of the Ottawa River; and, the area below the small generating station on the Mattawa River, the latter two areas known as spawning areas for walleye. Although there are no known spawning areas in the immediate vicinity of the GS, there is potential spawning habitat for pike and muskellunge downstream of the island. Walleye are also known to spawn in the Dumoine River, Magnasipi River, and several other tributaries to the river.

Wildlife

At least 14 species of water birds (including the black-backed gull) and three raptors have been reported to breed in this reach of the river (Table 5) (Cadman et al. 1987). Bald eagles are reported to over winter in the tailrace of Otto Holden GS.

Herring gulls and black-backed gulls use the station's sluiceway area for nesting.

Fourteen species of amphibians and reptiles have been reported in this reach (Table 6) (Oldham and Weller 2000).

Wetlands, parks, and environmentally sensitive areas

Few wetlands are found in this stretch of river. Only two wetlands of consequence are found between Des Joachims GS and Mattawa. They include the wetland complex at the mouth of Barbur Creek, approximately 5 km upstream of Deux Rivières and the wetland comprised of submergent/floating vegetation in the river section of Deux Rivières. Other wetlands are located at Santa Island, Gibson Creek and Grants Creek Bay.

Andre Linteau RPF is located on the Québec side just upstream of Des Joachims GS (Table 9) (SFEP 2001). The Town of Mattawa has Mattawa Explorers Point Park. Approximately 12 km upstream of Des Joachims GS is Driftwood Provincial Park, a 250 ha recreational park with sandy beaches formed by the impoundment of the river in 1950 (OMNR 2001a).

Shoreline development

Mattawa, a post founded by the Hudson's Bay Company in 1837, is the major town constructed along the shoreline of this reach of river. Since 1961 this community has experienced a decline in population (Ontario Water Resources Commission and Quebec Water Board 1972; Statistics Canada 2001) (Table 10).

There is little to no development along the Quebec shoreline, whereas the Highway 17 corridor extends along the Ontario side of the river between Petawawa and Mattawa. Several small communities, Deux Rivières and Bissett Creek, are located along this route.

There were no municipal or industrial water intakes identified downstream of Otto Holden GS. A total of 52 homes/cottages were identified downstream based on review of topographic and Ontario base maps.

In comparison to the whole Ottawa River watershed, there is limited agricultural land use in the watershed of this reach but the built-up area, 0.6 % of the Mattawa River sub-basin, is somewhat higher than most other reaches (Table 11) (Telmer 1996).

Lac la Cave (Otto Holden Dam to the Dam at Lake Temiscaming)

Pre-development description

La Cave Rapids were located approximately 8 km north of Mattawa. These rapids were at a bend and narrows of the river (Figure 56). There were two sets of rapids approximately 800 m apart. Figure 57 illustrates the top set of rapids prior to the construction of the Otto Holden Dam. These rapids had a natural fall of 3 m over ragged bedrock and contained pockets of rock rubble (Figure 58).

Existing physical description

Lac la Cave extends approximately 49 km upstream of the Otto Holden Dam to the Public Works Dam at the outlet of Lake Temiscaming. It has a surface area of 3,028 ha. A significant portion of this reach exceeds 20 m in depth, with many large basins below 50 m. The maximum depth recorded in this reach is 134 m.

Construction on the dam began in the fall of 1948 (Hydro-Electric Power Commission of Ontario 1950c). There were 1,254 ha of land cleared upstream from where the dam was constructed. A 731 m long diversion channel was excavated through rock on the eastern shoreline of the river (Figure 58) to allow for the construction of the dam (Biggar 1991). The dam was built at the head of the La Cave Rapids (Figures 56 and 59). The main dam is 762 m long and has a maximum height of 40 m (Figure 60) constructed above solid rock (Biggar 1991). Additional features of the Otto Holden Dam are outlined in Table 2. The Otto Holden Dam was completed by 1952 (Biggar 1991). The water levels were raised 22.9 m at the head of dam (Figure 9; Hydro-Electric Power Commission of Ontario 1950c), flooding an area of

13.7 km^2 (Efford 1975) upstream to the dam at Lake Temiscaming.

Crooked Rapids, Fourneau Rapids (Long Sault Rapids), Mountain Rapids, Rapids des Erable, and La Cave Rapids were all flooded (Figure 9) as a result of the construction of the Otto Holden Dam (Ottawa River Engineering Board 1965).

Larger tributaries include the Rivière Beauchene and Ruisseau Serpent in Québec, and the Jocko River in Ontario. The mean annual discharge of selected tributaries is described in Table 3.

This section of river is confined to a deep valley with moderate to steep shorelines extending to the water's edge (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et

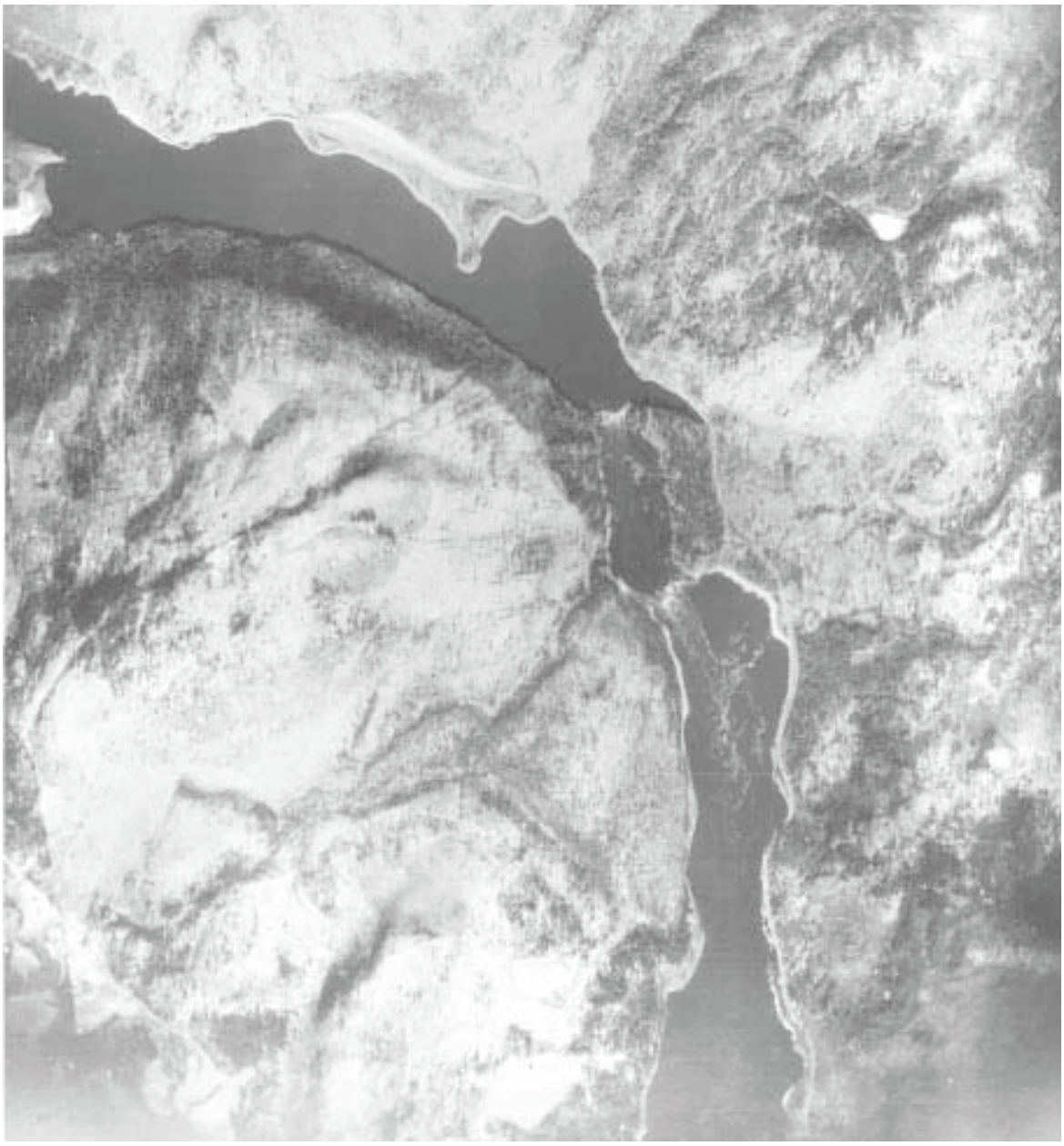

Figure 56. Aerial view of the La Cave Rapids prior to the construction of the Otto Holden Dam.

Figure 57. La Cave Rapids, 1948, site of the Otto Holden Dam (Hydro One Archives, Neg. No. 1938).

Figure 59. Aerial view of La Cave rapids during the construction of the bypass channel, 1949 (Hydro One Archives, Neg. No. 374)

Figure 58. View of the substrate of La Cave Rapids during the construction of the Otto Holden Dam, 1950 (Hydro One Archives, Neg, No. E52-291).

Figure 60. Otto Holden Dam (2000).

Parcs 1999). The shorelines are fairly regular with few islands or shallow bays.

Regulating dams upstream of Lac La Cave were constructed between 1911 and 1914 by the government of Canada: one above Quinze Rapids upstream of Lake Temiscaming; one at the outlet of Lake Temiscaming; and the third on the Kippawa River. These dams were built for the purpose of increasing the volume of flow of the Ottawa River at periods of low water (Ottawa River Engineering Board 1965).

Present hydrology

The mean annual discharge at Otto Holden is 692 m^3/s, with a drainage area of 47,900 km^2 (Telmer 1996).

Lac la Cave is a reservoir that experiences a winter drawdown starting in January (Figure 61). This section has a storage capacity of 120.8 million m^3 of water. There is an annual drawdown of 3.3 m and a maximum drawdown of 4.1 m (Efford 1975).

Time of travel for water from the Temiscaming Dam to Otto Holden is about 2–3 hours.

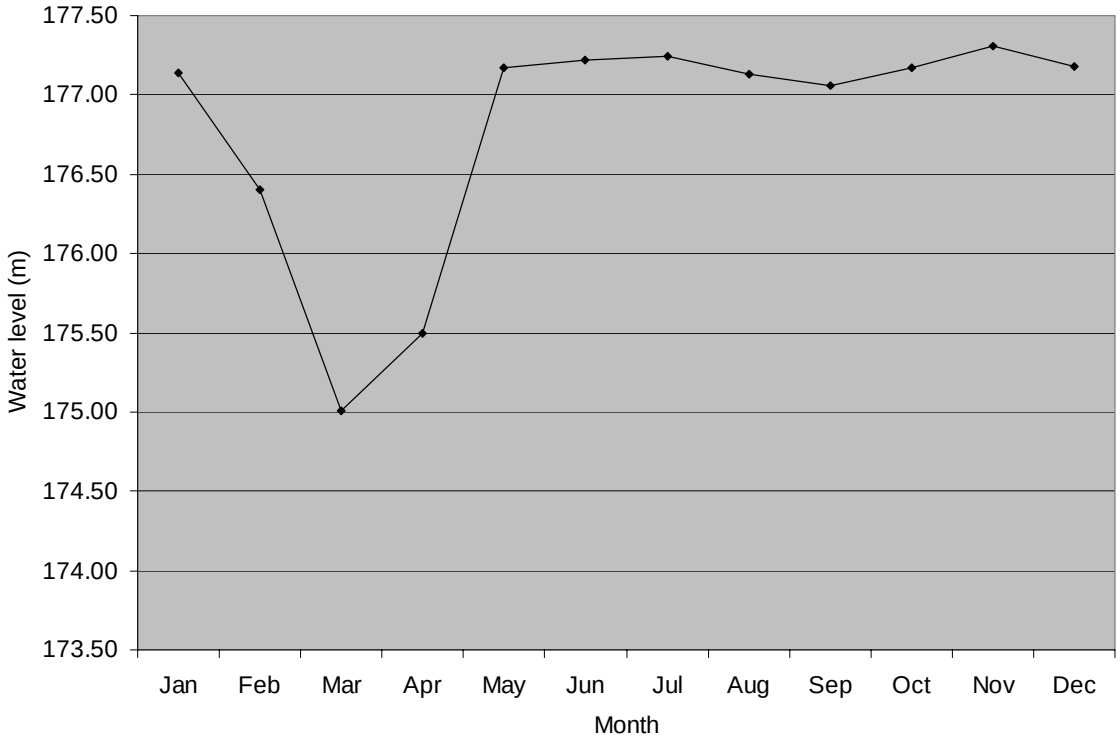

Figure 61. Mean monthly water levels in Lac la Cave over the past 50 years.

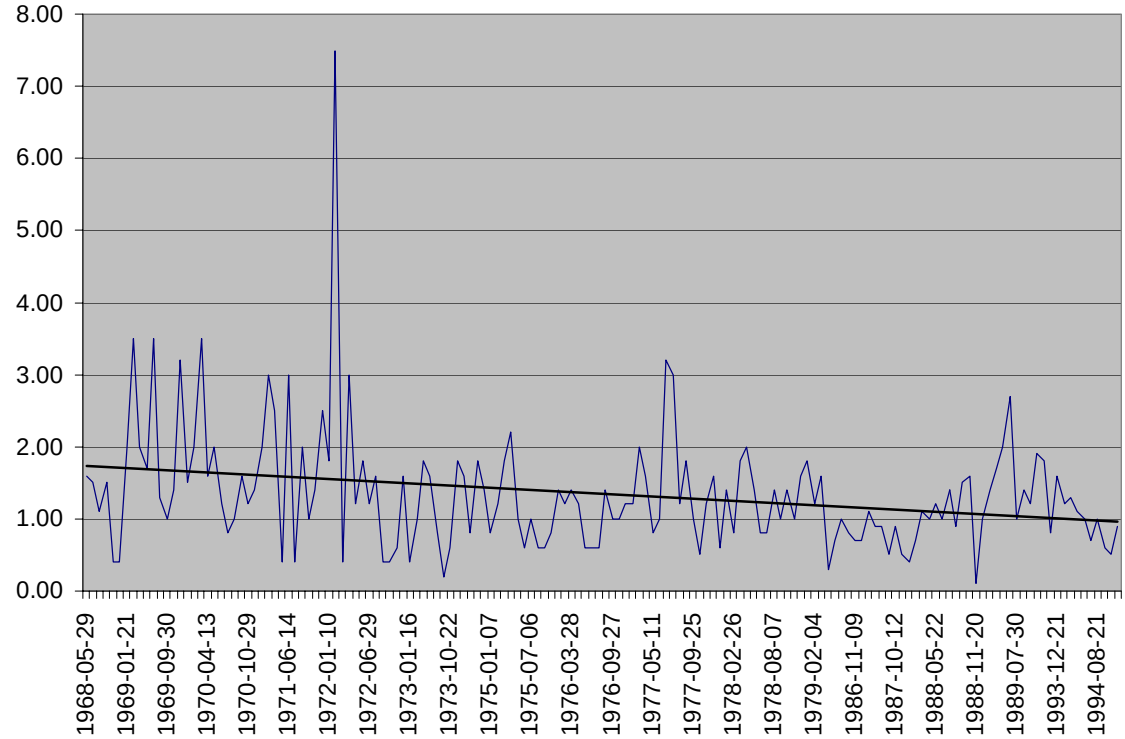

Figure 62. Biological Oxygen Demand levels at Otto Holden Dam, 1968 - 1994.

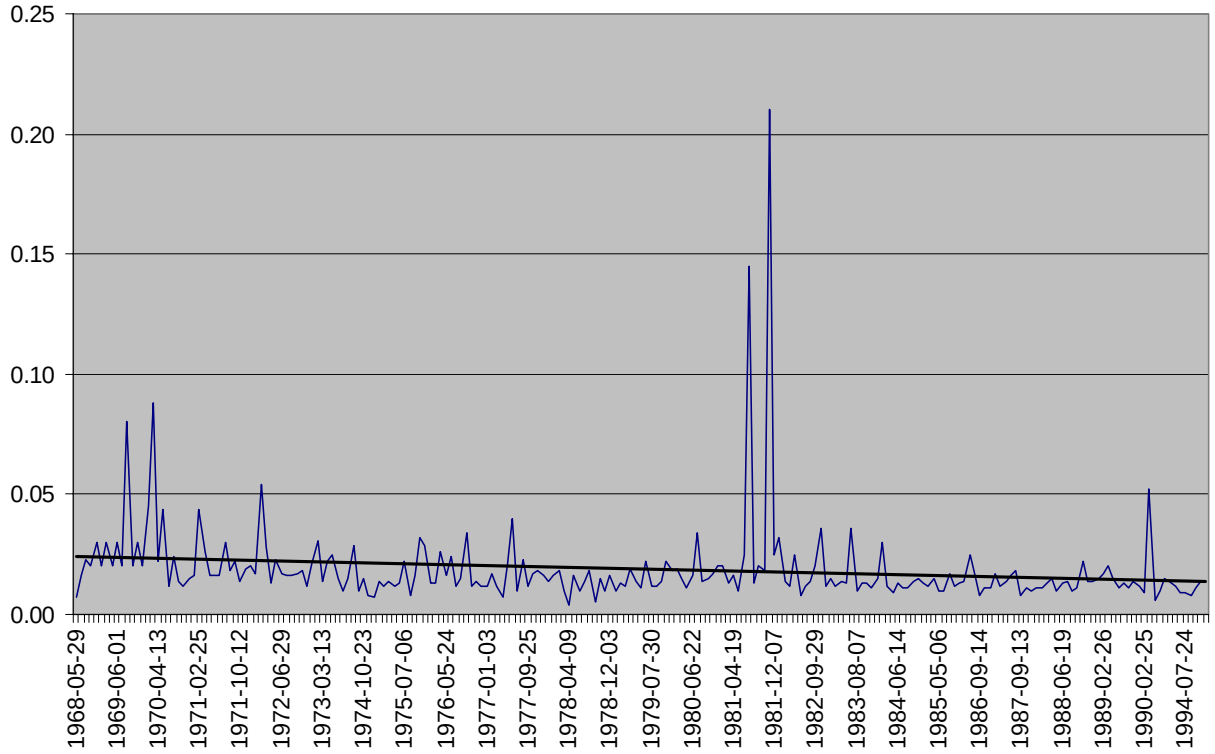

Figure 63. Total phosphorous levels at Otto Holden Dam, 1968 - 1994.

Chemical characteristics

Water quality has been historically influenced by the pulp and paper mill upstream at Temiscaming (Environment Canada et al. 1985). This reach of the river has previously experienced low dissolved oxygen levels and high ammonia levels (in the range of 0.2 milligrams per litre [mg/l]). In the past, BOD levels sampled at Otto Holden GS have tended to range between 0.5 and 3.0 mg/l (Figure 62) and total phosphorus between 0.02 and 0.05 mg/l (Figure 63). Total Kjeldahl nitrogen levels measured between 1971 and 1984 at Otto Holden have averaged around 0.45 mg/l with highs of 2.2 mg/l (Telmer 1996).

Natural environment

Fisheries

This reach supports primarily a coolwater fishery, although warmwater species are present. There are 30 species documented within this reach (Appendix 1). Walleye, sauger and northern pike are the predominant game fish although smallmouth bass are also present. Other species includes yellow perch, rock bass, common white suckers, lake herring, burbot, and the occasional brook trout (Table 4).

Lake sturgeon used to be present in this reach but the numbers have declined. Pollution from pulp and paper mills caused sturgeon to abandon deep sections in this reach due to oxygen depletion (Harkness and Dymond 1961).

Angling pressure is thought to be very light overall, with most fishing occurring near Temiscaming (Ontario Ministry of Natural Resources and Gouvernement du Québec Faune et Parcs 1999). Walleye, sauger, and perch are the main species sought.

Walleye spawn downstream of the public dam at Lake Temiscaming and in several tributaries throughout this section.

Wildlife

At least one water bird species, the common merganser, and four raptors, bald eagle, sharp-shinned hawk, broad-winged hawk, and red-tailed hawk, have been previously reported to breed in this reach of the river (Table 5) (Cadman et al. 1987). Bald eagles nest within this reach (Belfry pers. comm.[7]).

Four amphibian and reptile species have been reported in this reach (Table 6) (Oldham and Weller 2000).

Wetlands, parks, and environmentally sensitive areas

There are four ANSIs in this reach (Table 9) (OMNR 2001). They include three regionally significant ANSIs: Pinetree Point life science ANSI, Colton Narrows life science ANSI, and Jocko/Ottawa River earth science ANSI; and a provincially significant ANSI: Alexander Lake forest life science ANSI.

Shoreline development

There is very little development along the shoreline of this reach of river.

Summary

This report has attempted to collate and summarize the physical changes that occurred in the main portion of the Ottawa River upstream of Carillon to Lake Temicaming, particularly as a result of hydroelectric development. The more recent developments have been grander in scale, flooding more land and creating larger reservoirs. There are three sites in the main part of the river, which are under 1943 agreement for development by Hydro-Québec on the Ottawa River, that were never developed: the Rocher Fendu Channel site on the south side of Grand-Calumet Island and the Paquette site at Paquette Rapids; and between the Rapides des Îles power plant and the head of Lake Temiscaming (Ottawa River Engineering Board 1965). Although water flows are regulated, the white water section of the Chenal du Rocher Fendu gives us an example of what the Voyageurs and loggers had to contend with, along the entire length of the river. Sections of the river, such as Upper and Lower Allumette and Lac Coulonge, help us to understand large river ecosystems under near-natural conditions in comparison to more highly regulated sections of the river. It may even help us understand what the conditions of the river were like prior to the creation of impoundments with its potential levels of productivity.

While this report highlighted the changes to the Ottawa River, it does not detail the impacts or describe the changes that have occurred to each and every tributary or changes to the landscape. These changes could ultimately affect biota of the Ottawa River by blocking migration routes for spawning fish through the construction of a dam, or further altering the natural flow regime. In order to fully appreciate the changes that have occurred throughout the Ottawa River, a detailed historical and current review of conditions in the watershed would be necessary.

[7] Stephen Belfry, OMNR North Bay District, North Bay.

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Appendix 1. Fish species in the various reaches of the Ottawa River.

Reach	Common Name	Scientific Name	Last Year Documented
Lac la Cave			
	bluntnose shiner	*Pimephales notatus*	(Mandrak and Crossman 1992)
	brook stickleback	*Culea inconstans*	(Mandrak and Crossman 1992)
	brook trout	*Salvelinus fontinalis*	1999 (FWIN 1999b)
	burbot	*Lota lota*	1999 (FWIN 1999b)
	common shiner	*Notropis cornutus*	1999 (FWIN 1999b)
	creek chub	*Semotilus atromaculatus*	(Mandrak and Crossman 1992)
	emerald shiner	*Notropis atherinoides*	(Mandrak and Crossman 1992)
	fallfish	*Semotilus corporalis*	1999 (FWIN 1999b)
	fathead minnow	*Pimephales promelas*	(Mandrak and Crossman 1992)
	finescale dace	*Phoxinus neogaeus*	(Mandrak and Crossman 1992)
	freshwater drum	*Aplodinotus grunniens*	(Mandrak and Crossman 1992)
	golden shiner	*Notemigonus crysoleucas*	(Mandrak and Crossman 1992)
	johnny darter	*Etheostoma nigrum*	(Mandrak and Crossman 1992)
	lake chub	*Couesius plumbeus*	(Mandrak and Crossman 1992)
	lake whitefish	*Coregonus clupeaformis*	1999 (FWIN 1999b)
	logperch	*Percina caprodes*	(Mandrak and Crossman 1992)
	longnose gar	*Lepisosteus osseus*	(Mandrak and Crossman 1992)
	longnose sucker	*Catostomus catostomus*	1999 (FWIN 1999b)
	mooneye	*Hiodon tergisus*	(Mandrak and Crossman 1992)
	northern pike	*Esox lucius*	1999 (FWIN 1999b)
	northern redbelly dace	*Phoxinus eos*	(Mandrak and Crossman 1992)
	pearl dace	*Semotilus margarita*	(Mandrak and Crossman 1992)
	rock bass	*Ambloplites rupestris*	1999 (FWIN 1999b)
	sauger	*Stizostedion canadense*	1999 (FWIN 1999b)
	slimy sculpin	*Cottus cognatus*	(Mandrak and Crossman 1992)
	smallmouth bass	*Micropterus dolomieui*	1999 (FWIN 1999b)
	spottail shiner	*Notropis hudsonius*	1999 (FWIN 1999b)
	walleye	*Stizostedin vitreum*	1999 (FWIN 1999b)
	white sucker	*Catostomus commersoni*	1999 (FWIN 1999b)
	yellow perch	*Perca flavescens*	1999 (FWIN 1999b)

Appendix 1. Fish species in the various reaches of the Ottawa River—continued.

Reach	Common Name	Scientific Name	Last Year Documented
Holden Lake			
	blackchin shiner	*Notropis heterodon*	(Mandrak and Crossman 1992)
	blacknose shiner	*Notropis heterolepis*	(Rowan and Rasmussen 1996)
	bluegill	*Lepomis macrochirus*	(Mandrak and Crossman 1992)
	bluntnose shiner	*Pimephales notatus*	(Mandrak and Crossman 1992)
	brook stickleback	*Culea inconstans*	(Mandrak and Crossman 1992)
	brown bullhead	*Ictalurus nebulosus*	1998 (OMNR 1998)
	burbot	*Lota lota*	1998 (OMNR 1998)
	common shiner	*Notropis cornutus*	1998 (OMNR 1998)
	creek chub	*Semotilus atromaculatus*	1998 (OMNR 1998)
	emerald shiner	*Notropis atherinoides*	(Rowan and Rasmussen 1996)
	fallfish	*Semotilus corporalis*	(Mandrak and Crossman 1992)
	fathead minnow	*Pimephales promelas*	(Mandrak and Crossman 1992)
	finescale dace	*Phoxinus neogaeus*	(Mandrak and Crossman 1992)
	goldeye	*Hiodon alosoides*	1998 (OMNR 1998)
	lowa darter	*Etheostoma exile*	(Mandrak and Crossman 1992)
	johnny darter	*Etheostoma nigrum*	(Rowan and Rasmussen 1996)
	lake chub	*Couesius plumbeus*	(Mandrak and Crossman 1992)
	lake herring	*Coregonus artedii*	1980 (Migneault 1981)
	lake whitefish	*Coregonus clupeaformis*	1998 (OMNR 1998)
	logperch	*Percina caprodes*	(Rowan and Rasmussen 1996)
	longnose dace	*Rhinichthys cataractae*	(Mandrak and Crossman 1992)
	longnose sucker	*Catostomus catostomus*	1998 (OMNR 1998)
	mimic shiner	*Notrpos volucellus*	(Mandrak and Crossman 1992)
	northern pike	*Esox lucius*	1998 (OMNR 1998
	northern redbelly dace	*Phoxinus eos*	(Mandrak and Crossman 1992)
	pearl dace	*Semotilus margarita*	(Mandrak and Crossman 1992)
	rock bass	*Ambloplites rupestris*	1998 (OMNR 1998)
	rosyface shiner	*Notropis rubellus*	(Mandrak and Crossman 1992)
	sauger	*Stizostedion canadense*	1998 (OMNR 1998)
	shorthead redhorse	*Moxostoma macrolepidotum*	1998 (OMNR 1998)

Appendix 1. Fish species in the various reaches of the Ottawa River—continued.

Reach	Common Name	Scientific Name	Last Year Documented
Holden Lake (cont.)			
	silver redhorse	*Moxostoma anisurum*	1998 (OMNR 1998)
	smallmouth bass	*Micropterus dolomieui*	1998 (OMNR 1998)
	spottail shiner	*Notropis hudsonius*	(Rowan and Rasmussen 1996)
	walleye	*Stizostedin vitreum*	1998 (OMNR 1998)
	white sucker	*Catostomus commersoni*	1998 (OMNR 1998)
	yellow perch	*Perca flavescens*	1998 (OMNR 1998)
Allumette Lake			
	American eel	*Anguilla rostrata*	(Chabot and Caron 1996)
	banded killifish	*Fundulus diaphanus*	(Chabot and Caron 1996)
	blackchin shiner	*Notropis heterodon*	(Houston 1996a)
	blacknose shiner	*Notropis heterolepis*	(Mandrak and Crossman 1992)
	bluntnose shiner	*Pimephales notatus*	(Mandrak and Crossman 1992)
	brassy minnow	*Hybognathus hankinsoni*	(Mandrak and Crossman 1992)
	brook stickleback	*Culea inconstans*	(Mandrak and Crossman 1992)
	burbot	*Lota lota*	2000 (SPF 2000)
	channel catfish	*Ictalurus punctatus*	2001 (OMNR 2001c)
	common carp	*Cyprinus carpio*	(Chabot and Caron 1996)
	creek chub	*Semotilus atromaculatus*	(Mandrak and Crossman 1992)
	emerald shiner	*Notropis atherinoides*	(Chabot and Caron 1996)
	fallfish	*Semotilus corporalis*	2000 (SPF 2000)
	fathead minnow	*Pimephales promelas*	(Mandrak and Crossman 1992)
	finescale dace	*Phoxinus neogaeus*	(Mandrak and Crossman 1992)
	freshwater drum	*Aplodinotus grunniens*	(Mandrak and Crossman 1992)
	golden shiner	*Notemigonus crysoleucas*	(Mandrak and Crossman 1992)
	Iowa darter	*Etheostoma exile*	(Mandrak and Crossman 1992)
	johnny darter	*Etheostoma nigrum*	(Mandrak and Crossman 1992)
	lake herring	*Coregonus artedii*	2000 (SPF 2000)
	lake sturgeon	*Acipenser fulvescens*	2001 (OMNR 2001c)
	lake trout	*Salvelinus namaycush*	(Chabot and Caron 1996)
	lake whitefish	*Coregonus clupeaformis*	2000 (SPF 2000)

Appendix 1. Fish species in the various reaches of the Ottawa River—continued.

Reach	Common Name	Scientific Name	Last Year Documented
Allumette Lake			
	largemouth bass	Micropterus salmoides	2001 (OMNR 2001c)
	logperch	*Percina caprodes*	(Mandrak and Crossman 1992)
	longnose dace	*Rhinichthys cataractae*	(Mandrak and Crossman 1992)
	longnose gar	*Lepisosteus osseus*	2001 (OMNR 2001c)
	longnose sucker	*Catostomus catostomus*	1995 (Haxton 1998b)
	mimic shiner	*Notrpos volucellus*	(Mandrak and Crossman 1992)
	mooneye	Hiodon tergisus	2001 (OMNR 2001c)
	mottled sculpin	*Cottus bairdi*	(Mandrak and Crossman 1992)
	muskellunge	*Esox masquinongy*	2001 (OMNR 2001c)
	ninespine stickleback	*Pungitius pungitius*	(Chabot and Caron 1996)
	northern pike	*Esox lucius*	2001 (OMNR 2001c)
	northern redbelly dace	*Phoxinus eos*	(Mandrak and Crossman 1992)
	pearl dace	*Semotilus margarita*	(Mandrak and Crossman 1992)
	pumpkinseed	*Lepomis gibbosus*	2001 (OMNR 2001c)
	rainbow smelt	*Osmerus mordax*	(Chabot and Caron 1996)
	rainbow trout	*Salmo gairdneri*	1995 (Haxton 1998b)
	river redhorse	*Moxostoma carinatum*	2000 (SPF 2000)
	rock bass	*Ambloplites rupestris*	2001 (OMNR 2001c)
	rosyface shiner	*Notropis rubellus*	(Houston 1996b)
	sand shiner	*Notropis stramineus*	(Mandrak and Crossman 1992)
	sauger	*Stizostedion canadense*	2001 (OMNR 2001c)
	shorthead redhorse	*Moxostoma macrolepidotum*	2001 (OMNR 2001c)
	silver lamprey	*Icthymyzon unicuspis*	(Chabot and Caron 1996)
	silver redhorse	*Moxostoma anisurum*	2001 (OMNR 2001c)
	slimy sculpin	*Cottus cognatus*	(Mandrak and Crossman 1992)
	smallmouth bass	*Micropterus dolomieui*	2001 (OMNR 2001c)
	spottail shiner	*Notropis hudsonius*	1995 (Haxton 1998b)
	tessellated darter	*Etheostoma olmstedi*	(Mandrak and Crossman 1992)
	threespine stickleback	*Gasterosteus aculeatus*	1980 (Migneault 1981)
	walleye	*Stizostedin vitreum*	2001 (OMNR 2001c)

Appendix 1. Fish species in the various reaches of the Ottawa River—continued.

Reach	Common Name	Scientific Name	Last Year Documented
Allumette Lake			
	white sucker	Catostomus commersoni	2001 (OMNR 2001c)
	yellow bullhead	*Ictalurus natalis*	2001 (OMNR 2001c)
	yellow perch	*Perca flavescens*	2000 (SPF 2000)
Lower Allumette Lake			
	black crappie	*Pomoxis nigromaculatus*	1999 (Haxton 2000b)
	blackchin shiner	*Notropis heterodon*	(Houston 1996b)
	bluntnose shiner	*Pimephales notatus*	(Mandrak and Crossman 1992)
	brown bullhead	*Ictalurus nebulosus*	1999 (Haxton 2000b)
	channel catfish	*Ictalurus punctatus*	1999 (Haxton 2000b)
	emerald shiner	*Notropis atherinoides*	2001 (OMNR 2001b)
	fallfish	*Semotilus corporalis*	(Mandrak and Crossman 1992)
	golden shiner	*Notemigonus crysoleucas*	(Mandrak and Crossman 1992)
	johnny darter	*Etheostoma nigrum*	(Mandrak and Crossman 1992)
	lake sturgeon	*Acipenser fulvescens*	1999 (Haxton 2000b)
	largemouth bass	*Micropterus salmoides*	1999 (Haxton 2000b)
	logperch	*Percina caprodes*	(Mandrak and Crossman 1992)
	longnose gar	*Lepisosteus osseus*	1999 (Haxton 2000b)
	mooneye	*Hiodon tergisus*	1999 (Haxton 2000b)
	northern pike	*Esox lucius*	2001 (OMNR 2001b)
	pumpkinseed	*Lepomis gibbosus*	2001 (OMNR 2001b)
	river redhorse	*Moxostoma carinatum*	1999 (Haxton 2000b)
	rock bass	*Ambloplites rupestris*	1999 (Haxton 2000b)
	rosyface shiner	*Notropis rubellus*	(Houston 1996b)
	sauger	*Stizostedion canadense*	1999 (Haxton 2000b)
	shorthead redhorse	*Moxostoma macrolepidotum*	1999 (Haxton 2000b)
	silver redhorse	*Moxostoma anisurum*	1999 (Haxton 2000b)
	smallmouth bass	*Micropterus dolomieui*	1999 (Haxton 2000b)
	spottail shiner	*Notropis hudsonius*	2001 (OMNR 2001b)
	walleye	*Stizostedin vitreum*	1999 (Haxton 2000b)
	white sucker	*Catostomus commersoni*	1999 (Haxton 2000b)

Appendix 1. Fish species in the various reaches of the Ottawa River—continued.

Reach	Common Name	Scientific Name	Last Year Documented
Lower Allumette Lake			
	yellow bullhead	Ictalurus natalis	2001 (OMNR 2001b)
	yellow perch	*Perca flavescens*	2001 (OMNR 2001b)
Lac Coulonge			
	blackchin shiner	*Notropis heterodon*	(Houston 1996b)
	bluntnose shiner	*Pimephales notatus*	(Mandrak and Crossman 1992)
	brown bullhead	*Ictalurus nebulosus*	1999 (Haxton 2000a)
	burbot	*Lota lota*	1999 (Haxton 2000a)
	central mudminnow	*Umbra limi*	(Chabot and Caron 1996)
	channel catfish	*Ictalurus punctatus*	1999 (Haxton 2000a)
	emerald shiner	*Notropis atherinoides*	(Mandrak and Crossman 1992)
	fallfish	*Semotilus corporalis*	(Mandrak and Crossman 1992)
	fathead minnow	*Pimephales promelas*	(Mandrak and Crossman 1992)
	golden shiner	*Notemigonus crysoleucas*	(Mandrak and Crossman 1992)
	johnny darter	*Etheostoma nigrum*	(Mandrak and Crossman 1992)
	lake herring	*Coregonus artedii*	1970 (Haxton 1998b)
	lake sturgeon	*Acipenser fulvescens*	1999 (Haxton 2000a)
	lake whitefish	*Coregonus clupeaformis*	1970 (Haxton 1998b)
	largemouth bass	*Micropterus salmoides*	1999 (Haxton 2000a)
	logperch	*Percina caprodes*	(Mandrak and Crossman 1992)
	longnose gar	*Lepisosteus osseus*	1999 (Haxton 2000a)
	mooneye	*Hiodon tergisus*	1999 (Haxton 2000a)
	northern pike	*Esox lucius*	1999 (Haxton 2000a)
	pearl dace	*Semotilus margarita*	(Chabot and Caron 1996)
	pumpkinseed	*Lepomis gibbosus*	1999 (Haxton 2000a)
	river redhorse	*Moxostoma carinatum*	1999 (Haxton 2000a)
	rock bass	*Ambloplites rupestris*	1999 (Haxton 2000a)
	rosyface shiner	*Notropis rubellus*	(Houston 1996b)
	sauger	*Stizostedion canadense*	1999 (Haxton 2000a)
	shorthead redhorse	*Moxostoma macrolepidotum*	1999 (Haxton 2000a)
	silver redhorse	*Moxostoma anisurum*	1999 (Haxton 2000a)

Appendix 1. Fish species in the various reaches of the Ottawa River—continued.

Reach	Common Name	Scientific Name	Last Year Documented
Lac Coulonge			
	slimy sculpin	Cottus cognatus	(Chabot and Caron 1996)
	smallmouth bass	*Micropterus dolomieui*	1999 (Haxton 2000a)
	walleye	*Stizostedin vitreum*	1999 (Haxton 2000a)
	white sucker	*Catostomus commersoni*	1999 (Haxton 2000a)
	yellow bullhead	*Ictalurus natalis*	1980 (Migeault 1981)
	yellow perch	*Perca flavescens*	1999 (Haxton 2000a)
Lac du Rocher Fendu			
	blackchin shiner	*Notropis heterodon*	(Houston 1996b)
	brook stickleback	*Culea inconstans*	(Mandrak and Crossman 1992)
	brown bullhead	*Ictalurus nebulosus*	2000 (OMNR 2000a)
	burbot	*Lota lota*	1980 (Migeault 1981)
	channel catfish	*Ictalurus punctatus*	2000 (OMNR 2000a)
	emerald shiner	*Notropis atherinoides*	(Mandrak and Crossman 1992)
	freshwater drum	*Aplodinotus grunniens*	2000 (OMNR 2000a)
	johnny darter	*Etheostoma nigrum*	(Mandrak and Crossman 1992)
	lake sturgeon	*Acipenser fulvescens*	2000 (OMNR 2000a)
	largemouth bass	*Micropterus salmoides*	2000 (OMNR 2000a)
	longnose gar	*Lepisosteus osseus*	2000 (OMNR 2000a)
	mooneye	*Hiodon tergisus*	1997 (Haxton 1998)
	northern pike	*Esox lucius*	2000 (OMNR 2000a)
	pumpkinseed	*Lepomis gibbosus*	2000 (OMNR 2000a)
	river redhorse	*Moxostoma carinatum*	1997 (Haxton 1998)
	rock bass	*Ambloplites rupestris*	2000 (OMNR 2000a)
	rosyface shiner	*Notropis rubellus*	(Houston 1996b)
	sauger	*Stizostedion canadense*	2000 (OMNR 2000a)
	shorthead redhorse	*Moxostoma macrolepidotum*	2000 (OMNR 2000a)
	silver redhorse	*Moxostoma anisurum*	2000 (OMNR 2000a)
	smallmouth bass	*Micropterus dolomieui*	2000 (OMNR 2000a)
	walleye	*Stizostedin vitreum*	2000 (OMNR 2000a)
	white sucker	*Catostomus commersoni*	2000 (OMNR 2000a)

Appendix 1. Fish species in the various reaches of the Ottawa River—continued.

Reach	Common Name	Scientific Name	Last Year Documented
Lac du Rocher Fendu			
	yellow bullhead	Ictalurus natalis	1980 (Migeault 1981)
	yellow perch	*Perca flavescens*	2000 (OMNR 2000a)
Lac des Chats			
	American eel	*Anguilla rostrata*	1998 (Haxton 1999)
	banded killifish	*Fundulus diaphanus*	1990 (Haxton 1998b)
	black crappie	*Pomoxis nigromaculatus*	1998 (Haxton 1999)
	blackchin shiner	*Notropis heterodon*	1977 (Dunford 1977)
	blacknose shiner	*Notropis heterolepis*	1977 (Dunford 1977)
	bluegill	*Lepomis macrochirus*	(Mandrak and Crossman 1992)
	bluntnose shiner	*Pimephales notatus*	1990 (Haxton 1998b)
	brown bullhead	*Ictalurus nebulosus*	1998 (Haxton 1999)
	burbot	*Lota lota*	1997 (Haxton 1998b)
	channel catfish	*Ictalurus punctatus*	1998 (Haxton 1999)
	common carp	*Cyprinus carpio*	(Chabot and Caron 1996)
	creek chub	*Semotilus atromaculatus*	(Mandrak and Crossman 1992)
	emerald shiner	*Notropis atherinoides*	1990 (Haxton 1998b)
	fallfish	*Semotilus corporalis*	(Mandrak and Crossman 1992)
	golden shiner	*Notemigonus crysoleucas*	1986 (Haxton 1998b)
	goldeye	*Hiodon alosoides*	1961 (Haxton 1998b)
	greater redhorse	*Moxostoma valenciennesi*	1998 (Haxton 1999)
	Iowa darter	*Etheostoma exile*	1977 (Dunford 1977)
	johnny darter	*Etheostoma nigrum*	1990 (Haxton 1998b)
	lake sturgeon	*Acipenser fulvescens*	1998 (Haxton 1999)
	lake whitefish	*Coregonus clupeaformis*	1961 (Haxton 1998b)
	largemouth bass	*Micropterus salmoides*	1998 (Haxton 1999)
	logperch	*Percina caprodes*	1990 (Haxton 1998b)
	longnose gar	*Lepisosteus osseus*	1998 (Haxton 1999)
	longnose sucker	*Catostomus catostomus*	(Chabot and Caron 1996)
	mimic shiner	*Notrpos volucellus*	1977 (Dunford 1977)
	mooneye	*Hiodon tergisus*	1997 (Haxton 1998b)

Appendix 1. Fish species in the various reaches of the Ottawa River—continued.

Reach	Common Name	Scientific Name	Last Year Documented
Lac des Chats			
	muskellunge	*Esox masquinongy*	1998 (Haxton 1999)
	northern pike	*Esox lucius*	1998 (Haxton 1999)
	pumpkinseed	*Lepomis gibbosus*	1997 (Haxton 1998b)
	river redhorse	*Moxostoma carinatum*	1998 (Haxton 1999)
	rock bass	*Ambloplites rupestris*	1998 (Haxton 1999)
	rosyface shiner	*Notropis rubellus*	(Mandrak and Crossman 1992)
	sauger	*Stizostedion canadense*	1997 (Haxton 1998b)
	shorthead redhorse	*Moxostoma macrolepidotum*	1997 (Haxton 1998b)
	silver redhorse	*Moxostoma anisurum*	1998 (Haxton 1999)
	smallmouth bass	*Micropterus dolomieui*	1998 (Haxton 1999)
	spottail shiner	*Notropis hudsonius*	1990 (Haxton 1998b)
	walleye	*Stizostedin vitreum*	1998 (Haxton 1999)
	white sucker	*Catostomus commersoni*	1998 (Haxton 1999)
	yellow bullhead	*Ictalurus natalis*	1998 (Haxton 1999)
	yellow perch	*Perca flavescens*	1997 (Haxton 1998b)
Lac Deschenes			
	American eel	*Anguilla rostrata*	1989 (OMNR 1989)
	banded killifish	*Fundulus diaphanus*	(Mandrak and Crossman 1992)
	black bullhead	*Ictalurus melas*	(Mandrak and Crossman 1992)
	black crappie	*Pomoxis nigromaculatus*	2000 (OMNR 2000b)
	blackchin shiner	*Notropis heterodon*	(Mandrak and Crossman 1992)
	blacknose shiner	*Notropis heterolepis*	(Mandrak and Crossman 1992)
	bluegill	*Lepomis macrochirus*	1989 (OMNR 1989)
	bluntnose shiner	*Pimephales notatus*	(Mandrak and Crossman 1992)
	brook stickleback	*Culea inconstans*	(Mandrak and Crossman 1992)
	brown bullhead	*Ictalurus nebulosus*	2000 (OMNR 2000b)
	brown trout	*Salmo trutta*	(Chabot and Caron 1996)
	burbot	*Lota lota*	1991 (OMNR 1991b)
	central mudminnow	*Umbra limi*	(Chabot and Caron 1996)
	channel catfish	*Ictalurus punctatus*	2000 (OMNR 2000b)

Appendix 1. Fish species in the various reaches of the Ottawa River—continued.

Reach	Common Name	Scientific Name	Last Year Documented
Lac Deschenes			
	channel darter	*Percina copelandi*	(Goodchild 1994)
	common carp	*Cyprinus carpio*	2000 (OMNR 2000b)
	common shiner	*Notropis cornutus*	(Chabot and Caron 1996)
	creek chub	*Semotilus atromaculatus*	(Mandrak and Crossman 1992)
	eastern silvery minnow	*Hybognathus regius*	(Chabot and Caron 1996)
	emerald shiner	*Notropis atherinoides*	(Mandrak and Crossman 1992)
	fallfish	*Semotilus corporalis*	(Mandrak and Crossman 1992)
	fathead minnow	*Pimephales promelas*	(Mandrak and Crossman 1992)
	golden shiner	*Notemigonus crysoleucas*	(Mandrak and Crossman 1992)
	Iowa darter	*Etheostoma exile*	(Mandrak and Crossman 1992)
	johnny darter	*Etheostoma nigrum*	(McAllister et al. 1972)
	lake herring	*Coregonus artedii*	(Chabot and Caron 1996)
	lake sturgeon	*Acipenser fulvescens*	1991 (OMNR 1991b)
	largemouth bass	*Micropterus salmoides*	2000 (OMNR 2000b)
	logperch	*Percina caprodes*	2001 (OMNR 2001a)
	longnose dace	*Rhinichthys cataractae*	(Mandrak and Crossman 1992)
	longnose gar	*Lepisosteus osseus*	2000 (OMNR 2000b)
	longnose sucker	*Catostomus catostomus*	1991 (OMNR 1991b)
	mimic shiner	*Notrpos volucellus*	(Mandrak and Crossman 1992)
	mooneye	*Hiodon tergisus*	1991 (OMNR 1991b)
	mottled sculpin	*Cottus bairdi*	(Mandrak and Crossman 1992)
	muskellunge	*Esox masquinongy*	1990 (Niblett 1990)
	ninespine stickleback	*Pungitius pungitius*	(Chabot and Caron 1996)
	northern pike	*Esox lucius*	2000 (OMNR 2000b)
	northern redbelly dace	*Phoxinus eos*	(Mandrak and Crossman 1992)
	pearl dace	*Semotilus margarita*	(Mandrak and Crossman 1992)
	pumpkinseed	*Lepomis gibbosus*	2000 (OMNR 2000b)
	rainbow smelt	*Osmerus mordax*	(Chabot and Caron 1996)
	river redhorse	*Moxostoma carinatum*	1989 (OMNR 1989)

Appendix 1. Fish species in the various reaches of the Ottawa River—continued.

Reach	Common Name	Scientific Name	Last Year Documented
Lac Deschenes			
	rock bass	*Ambloplites rupestris*	2000 (OMNR 2000b)
	rosyface shiner	*Notropis rubellus*	(Mandrak and Crossman 1992)
	sand shiner	*Notropis stramineus*	(Mandrak and Crossman 1992)
	sauger	*Stizostedion canadense*	1991 (OMNR 1991b)
	shorthead redhorse	*Moxostoma macrolepidotum*	1991 (OMNR 1991b)
	silver lamprey	*Icthymyzon unicuspis*	(Chabot and Caron 1996)
	silver redhorse	*Moxostoma anisurum*	2000 (OMNR 2000b)
	smallmouth bass	*Micropterus dolomieui*	2001 (OMNR 2001a)
	spottail shiner	*Notropis hudsonius*	(Mandrak and Crossman 1992)
	tessellated darter	*Etheostoma olmstedi*	(McAllister et al. 1972)
	walleye	*Stizostedin vitreum*	2000 (OMNR 2000b)
	white sucker	*Catostomus commersoni*	2000 (OMNR 2000b)
	yellow bullhead	*Ictalurus natalis*	1991 (OMNR 1991b)
	yellow perch	*Perca flavescens*	2001 (OMNR 2001a)
Dollards des Ormeaux			
	alewife	*Alosa pseudoharehgus*	1993 (OMNR 1993)
	American brook lamprey	*Lampetra appendix*	1979 (Lanteigne et al. 1981)
	American eel	*Anguilla rostrata*	1995 (OMNR 1995)
	American shad	*Alosa sapidissima*	1993 (OMNR 1993)
	banded killifish	*Fundulus diaphanus*	1973 (Anonymous 1973)
	black crappie	*Pomoxis nigromaculatus*	1995 (OMNR 1995)
	blackchin shiner	*Notropis heterodon*	(Mandrak and Crossman 1992)
	blacknose dace	*Rhinichthys atratulus*	(Mandrak and Crossman 1992)
	bluegill	*Lepomis macrochirus*	1973 (Qadri and Rubec 1977)
	bluntnose shiner	*Pimephales notatus*	(Mandrak and Crossman 1992)
	brassy minnow	*Hybognathus hankinsoni*	(Mandrak and Crossman 1992)
	brook silverside	*Labidesthes sicculus*	(Goodchild 1990)
	brook stickleback	*Culea inconstans*	(Mandrak and Crossman 1992)
	brown bullhead	*Ictalurus nebulosus*	1995 (OMNR 1995)
	brown trout	Salmo trutta	(Chabot and Caron 1996)

Appendix 1. Fish species in the various reaches of the Ottawa River—continued.

Reach	Common Name	Scientific Name	Last Year Documented
Dollards des Ormeaux			
	burbot	*Lota lota*	1991 (OMNR 1991)
	central mudminnow	*Umbra limi*	(Chabot and Caron 1996)
	channel catfish	*Ictalurus punctatus*	1995 (OMNR 1995)
	common carp	*Cyprinus carpio*	1995 (OMNR 1995)
	common shiner	*Notropis cornutus*	(Chabot and Caron 1996)
	creek chub	*Semotilus atromaculatus*	(Mandrak and Crossman 1992)
	cutlips minnow	*Exoglossum maxillingua*	(Mandrak and Crossman 1992)
	eastern silvery minnow	*Hybognathus regius*	1977 (Hanson and Qadri 1979)
	emerald shiner	*Notropis atherinoides*	1977 (Hanson and Qadri 1979)
	fallfish	*Semotilus corporalis*	1973 (Anonymous 1973)
	fantail darter	*Etheostoma flabellare*	(Scott and Crossman 1973)
	fathead minnow	*Pimephales promelas*	(Mandrak and Crossman 1992)
	finescale dace	*Phoxinus neogaeus*	(Mandrak and Crossman 1992)
	freshwater drum	*Aplodinotus grunniens*	1993 (OMNR 1993)
	golden shiner	*Notemigonus crysoleucas*	1991 (OMNR 1991)
	greater redhorse	*Moxostoma valenciennesi*	1973 (Qadri and Rubec 1977)
	Iowa darter	*Etheostoma exile*	1979 (Hanson and Qadri 1980)
	johnny darter	*Etheostoma nigrum*	1979 (Hanson and Qadri 1980)
	lake herring	*Coregonus artedii*	(Chabot and Caron 1996)
	lake sturgeon	*Acipenser fulvescens*	1995 (OMNR 1995)
	largemouth bass	*Micropterus salmoides*	1995 (OMNR 1995)
	logperch	*Percina caprodes*	1973 (Anonymous 1973)
	longear sunfish	*Lepomis magalotis*	(Chabot and Caron 1996)
	longnose dace	*Rhinichthys cataractae*	(Mandrak and Crossman 1992)
	longnose gar	*Lepisosteus osseus*	1995 (OMNR 1995)
	longnose sucker	*Catostomus catostomus*	1995 (OMNR 1995)
	marignated madtom	*Noturus insignis*	(Chabot and Caron 1996)
	mimic shiner	*Notrpos volucellus*	(Mandrak and Crossman 1992)
	mooneye	*Hiodon tergisus*	1993 (OMNR 1993)
	mottled sculpin	Cottus bairdi	(Mandrak and Crossman 1992)

Appendix 1. Fish species in the various reaches of the Ottawa River—continued.

Reach	Common Name	Scientific Name	Last Year Documented
Dollards des Ormeaux			
	muskellunge	*Esox masquinongy*	1993 (OMNR 1993)
	ninespine stickleback	*Pungitius pungitius*	(Chabot and Caron 1996)
	northern brook lamprey	*Ichthymyzon fossor*	(Mandrak and Crossman 1992)
	northern pike	*Esox lucius*	1995 (OMNR 1995)
	northern redbelly dace	*Phoxinus eos*	(Mandrak and Crossman 1992)
	pearl dace	*Semotilus margarita*	(Mandrak and Crossman 1992)
	pumpkinseed	*Lepomis gibbosus*	1995 (OMNR 1995)
	quillback	*Carpoides cyprinus*	1995 (OMNR 1995)
	rainbow smelt	*Osmerus mordax*	(Chabot and Caron 1996)
	river redhorse	*Moxostoma carinatum*	1993 (OMNR 1993)
	rock bass	*Ambloplites rupestris*	1995 (OMNR 1995)
	rosyface shiner	*Notropis rubellus*	(Mandrak and Crossman 1992)
	sand shiner	*Notropis stramineus*	(Mandrak and Crossman 1992)
	sauger	*Stizostedion canadense*	1995 (OMNR 1995)
	shorthead redhorse	*Moxostoma macrolepidotum*	1995 (OMNR 1995)
	silver lamprey	*Icthymyzon unicuspis*	1980 (Pariseau and Dumont 1980)
	silver redhorse	*Moxostoma anisurum*	1995 (OMNR 1995)
	slimy sculpin	*Cottus cognatus*	(Mandrak and Crossman 1992)
	smallmouth bass	*Micropterus dolomieui*	1995 (OMNR 1995)
	spotfin shiner	*Notropis spilopterus*	(Mandrak and Crossman 1992)
	spottail shiner	*Notropis hudsonius*	1973 (Anonymous 1973)
	stonecat	*Noturus flavus*	(Mandrak and Crossman 1992)
	tadpole madtom	*Noturus gyrinus*	(Mandrak and Crossman 1992)
	tessellated darter	*Etheostoma olmstedi*	(McAllister et al. 1972)
	trout-perch	*Percopsis omiscomaycus*	(Chabot and Caron 1996)
	walleye	*Stizostedin vitreum*	1995 (OMNR 1995)
	white crappie	*Pomoxis annularis*	1993 (OMNR 1993)
	white sucker	*Catostomus commersoni*	1995 (OMNR 1995)
	yellow bullhead	*Ictalurus natalis*	1995 (OMNR 1995)
	yellow perch	Perca flavescens	1995 (OMNR 1995)